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The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

THE COLOMBIAN BERRY.....WILSON POPENOE

ENVIRONMENT AND BREEDING.....ANDREW C. MCCANDLISH

HEREDITY IN HORSES.....H. K. BUSH-BROWN

MENACE OF THE HALF-MAN.....SETH K. HUMPHREY

GRAFT-CHIMERA IN APPLES.....A. B. STOUT

BREEDING EARLESS SHEEP.....E. G. RITZMAN

ORGAN OF THE
AMERICAN GENETIC ASSOCIATION
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The American Genetic Association

An incorporated organization devoted to promoting a knowledge of the laws of heredity and their application to the improvement of plants, animals, and human racial stocks.

Its membership is composed of men of science, teachers, publicists, physicians, clergymen, parents, students, horticulturists, and breeders of live stock throughout the world.

The Association owns the JOURNAL OF HEREDITY, which is published monthly and sent to each member without additional cost. Every member is thus a part owner of the JOURNAL.

Membership imposes no burdensome obligations. The Association, which is cooperative in nature, welcomes assistance in research, but does not demand it. Members are invited to submit discussions of the results of their research, accompanied by new and unusual photographs. All papers received will be given full consideration by the editorial board.

Hundreds of members are engaged in collecting facts about inheritance, and making experiments to determine the laws of heredity. Their discoveries are of fascinating interest and far-reaching importance to the city dweller and the country dweller alike. These findings are being reported and discussed every month in the JOURNAL, and in no better way can serious minded people keep abreast of one of the greatest movements of modern science.

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The Association welcomes all who are interested in its program, and the Secretary will be glad to answer any inquiries.

Annual dues, giving the right to attend all meetings, and receive the JOURNAL OF HEREDITY, are $3 within the United States and its possessions; $3.25 in Canada, and $3.50 in all other foreign countries; life membership, $50.

If you are not already a member, and want to become one, or if you know of anyone who you think is interested in membership, write to

THE AMERICAN GENETIC ASSOCIATION

Box 412 Eleventh Street Station Washington, D. C.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

VOL. XI, NO. 5 MAY-JUNE, 1920

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NOTE

The Journal of Heredity at the original pre-war price of only $2.00 ran into a raise of fully 100% in the cost of its manufacture. The membership dues did not cover the costs, and support was difficult to arrange for, but the necessary financial assistance has been secured, and four bi-monthly numbers will now appear in quick succession to complete Volume eleven (1920). The Journal will then resume its regular schedule at the price of $3.00 determined upon by the Council last June.

Canadian members pay $3.25 and foreign members $3.50, the extra amount being necessary to pay postage. Price of single copies 35 cents.

The next numbers will contain illustrated accounts of some of the most important discoveries which have yet been made in this new field of science, and it is hoped will satisfy those members to whom the long wait for the Journal has been discouraging.

The interest in the subject of heredity is growing rapidly, and if each member would nominate a few friends who are eligible the Association will be self-supporting next year.

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Date of issue of this number, January 20, 1921

COLOMBIA'S GIFT TO AMERICAN PLANT BREEDERS

A Colombian Highlander Holding Up an Armful of the Giant Blackberry of the Rain Forest of Fusagasuga

This remarkable species does not form compact bushes but sends up scattered shoots from underground stems. It is half climbing in habit, its stems reaching to a height of ten feet. At the base of each leaf is a pair of clasping stipules which distinguish it from other species. The flower clusters (terminal racemes) rarely carry more than five flowers and often only one fruit is set. In the photograph the berries are scarcely more than half grown. Photograph by Wilson Popenoe, October 1920. (Frontispiece.)

THE COLOMBIAN BERRY OR GIANT BLACKBERRY OF COLOMBIA

WILSON POPENOE
Agricultural Explorer, Office of Foreign Seed and Plant Introduction

THAT a fruit of such remarkable character as the Giant Blackberry of Colombia should have remained so long undiscovered to horticulture can only be explained by the fact that it grows in a region remote from the established routes of travel—a region which has, until recently, remained horticulturally unexplored.

So far as known, the species has never been called to the attention of the horticultural public. It was, however, brought to the attention of the U. S. Department of Agriculture several years ago by Dr. Frank M. Chapman of the American Museum of Natural History, who had observed the plant during his travels in Colombia. The services of Frederick L. Rockwood were enlisted at Dr. Chapman's suggestion, and in 1914 a few plants were introduced into the United States through the Office of Foreign Seed and Plant Introduction. These plants were obtained by Mr. Rockwood at a spot called El Peñon, on the road between Sibaté and Fusagasugá, in the department of Cundinamarca.

SEED AND PLANTS OBTAINED

Soon after my arrival in Bogotá I put myself in touch with Mr. Rockwood, and by him was directed to the region in which the plant is found most abundantly. I have been on the watch for it in other parts of Cundinamarca as well, and have thus been able to gain some idea of its distribution. I have obtained numerous photographs of the plants, flowers and fruits; botanical specimens of foliage and flowers; and I have forwarded to Washington a quantity of seed and a limited number of strong young plants. With this material in hand, it should be possible to arouse the interest of North American horticulturists in the species, and to give it a fairly wide distribution in those portions of the United States where it seems to merit a trial.

VALUABLE MATERIAL FOR PLANT BREEDERS

While the plant grows in Colombia at elevations nearly ten thousand feet above the sea, it must be remembered that at four degrees from the Equator it is not cold, even at such an elevation: and there are no grounds for assuming that the plant will be sufficiently hardy for cultivation generally throughout the United States. It does seem reasonable to expect, however, that it will be successful in the milder portions of the South and West. The chief interest of the species probably lies, however, not in its value as a fruit for widespread cultivation in its present form, but in its possibilities when placed in the hands of plant breeders. A species of Rubus which produces, as a wild plant, fruits two and a half inches long by an inch and a half in thickness, and these of fairly good quality for eating, can not fail to possess great interest to North American horticulturists!

DISTRIBUTION AND NOMENCLATURE

The species was reported by Dr. Chapman from a region on the road between Sibaté and Fusagasugá. While it occurs elsewhere in Cundinamarca, I have found no other region, as yet, in which it is so abundant, nor in which the fruits reach such large size.

Its distribution in the region between Sibaté and Fusagasugá is limited to an area bounded on the north by the descent onto the sabana (plain) of Bogotá, and on the south by the abrupt

A BASKET OF THE COLOMBIAN BERRY, NATURAL SIZE

When it is considered that this berry is a wild one, having never been brought under cultivation, that its individual fruits measure 2¼ inches in length as they are picked from the wild bushes and that plants of it have wintered through when protected in the Puget Sound region where some of the finest berries in the country are produced, the possible value of this gift from our sister republic COLOMBIA becomes apparent. What breeding and selection may do with this berry must be left to the Plant Breeders to determine. Photograph by Wilson Popenoe. October 1920. (Fig. 1.)

descent of the peñon into the valley of the Rio Barroblanco. This leaves a zone about one mile in width, in which the plant is found—a zone on the upper edge of the escarpment, but not extending across the mountain tops onto the slope toward the sabana. The region is one of peculiar climatic conditions: it is that upon which the clouds drifting up from the lowlands of the Magdalena valley impinge and frequently precipitate their moisture, and it is thus kept cool and wet throughout most of the year. It is a region characterized by tree-ferns, bamboo, begonias, several melastomaceous and ericaceous shrubs, *Drimys granatensis*, one or two species of Berberis, and several species of Rubus which sometimes cover the ground over areas an acre or more in extent.

EXTENT OF RANGE NOT KNOWN

Elsewhere in Cundinamarca I have seen the plant, or learned of its existence, only on the western or southwestern slope of the range which rises from the western edge of the sabana of Bogotá and falls away toward the Magdalena valley. Mr. Rockwood has recently reported the plant from Dentel, north of Facatativá. So far as I have observed, it is found only at elevations between 8,000 and 10,000 feet; further observations may, and probably will, extend this range.

SPECIES PROBABLY *Rubus roseus*

Botanically I have not been able to determine the species. No one in Bogotá with whom I have talked is familiar with the botany of this genus, and none of the local botanical works to which I have had access describe a plant which I can identify as this species. The characters of the plant seem to agree with those attributed to *Rubus roseus* in a key to the Central and South American species of Rubus which has been sent me by George M. Darrow. They also agree rather closely with those of *Rubus macrocarpus*, except that the latter is many-flowered, and I do not think this can be said of the plant in question. *Rubus roseus*, on the other hand, is said to produce few flowers; its fruit is described as "purple," which is not exactly true of the Colombian Giant Blackberry; yet it would be easy for a slight mistake to be made in this matter, and it seems to me on the whole that the characters of *Rubus roseus*, as given in the key, are those of the plant under consideration.

The popular nomenclature of the different species of Rubus in the Bogotá region is limited to a few terms applied rather loosely. In general, all of the species which produce fruits of blackberry character are termed *mora*, the correct name in Spanish for the mulberry (*Morus nigra*) and also for the fruit of the cultivated blackberry. One or more species whose fruits have large, hard seeds are termed *mora de poedra*, or stone-blackberry, because (I take it) their seeds are like small stones (though one Colombian told me it was because they grow in stony places, which is not commonly a fact). Several species whose fruits are of good quality for eating, and are sold in the markets of Bogotá and other cities, are called *mora de Castilla*, or blackberry of Castile (Spain). The phrase *de Castilla* is applied in Cundinamarca to various products of the country; thus there is a *curuba de Castilla* (*Tacsonia mollissima*), no more a native of Spain than the various species of Rubus to which the term is applied. The phrase *de Castilla* may, in fact, be taken to mean that the product is one of the best of its class. It is undoubtedly a heritage from Colonial days, when the best of everything was supposed to come from the Mother Country.

The Giant Blackberry is termed by natives of the Peñon section *mora*, and *mora* alone; though when pressed for a more specific name they will sometimes say it is a *mora de Castilla*, i.e., a good mora. In Bogotá the fruit is often termed *mora de Castilla*, but this name is applied to at least two other species which are more common in the market than the one under consideration.

AN ENGLISH NAME FOR THE BERRY

The species has, of course, no common name in English as yet. On those few occasions when it has been mentioned in the United States, it has usually been referred to as the Giant Blackberry of Colombia. Since the fruit is not black and the plant differs in habit from the cultivated blackberries of the North, I believe it would be appropriate to introduce the species into horticulture not as the Giant Blackberry, but as the Colombian Berry; thus doing honor to Colombia, and at the same time identifying the species permanently with its native home, and distinguishing it from numerous "giant" blackberries which have been and will be introduced into horticulture in the United States. The term "Colombian berry" is in conformity with the nomenclature used in this genus, in which we already have loganberry, salmon berry, Northey berry, and so on.

DESCRIPTION OF PLANT

The plant, which does not form a compact bush in most instances, but sends up scattered shoots from underground stems, is half-climbing in habit. By proper training it could probably be made to form a shapely bush, or at least the canes could be so pruned as not to require any support. In the wild state, many of the canes grow half erect, while others scramble over the nearby vegetation.

The stems reach a maximum length of about nine or ten feet. Near the ground they are commonly half an inch thick, the diameter growing less toward the upper portion of the stem. They are light green in color, covered with short glandular reddish hairs, and abundantly armed with short, stiff, very slightly recurved thorns broad at the base.

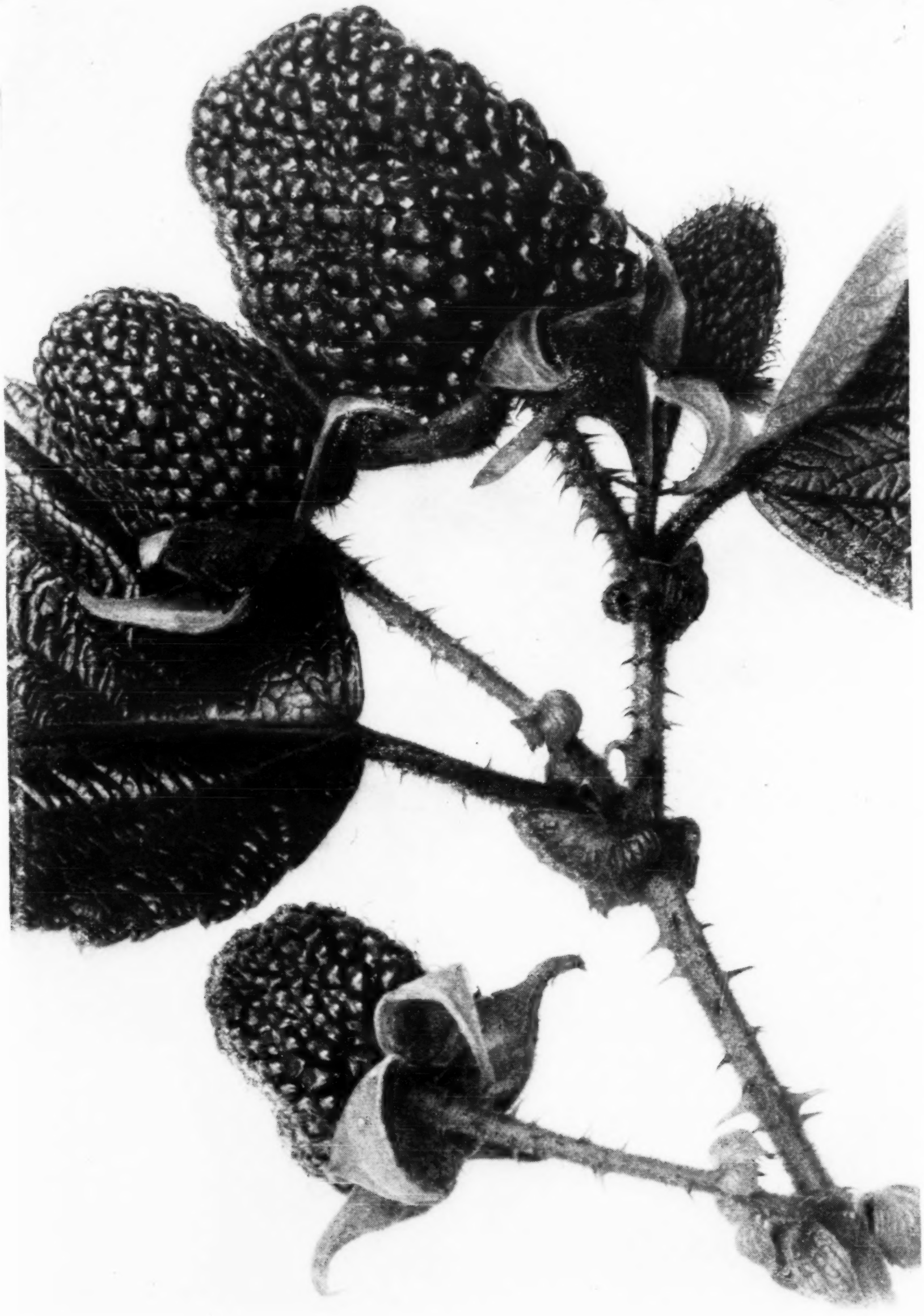
A pair of leaf-like, clasping stipules, about an inch in length and breadth, is found at the base of each of the leaves. The latter are normally trifoliate, and up to more than a foot in length. The petiole is up to six inches long, slightly grooved above, thorny and hairy like the canes. The petiolules of the lateral pair of leaflets are one-fourth to one-half inch long, that of the central or terminal leaflet one to two inches long. The leaflets are commonly oblong-ovate, elliptic, or ovate in outline, subcrenate, three to six inches long, cordate at the base and acute to shortly acuminate at the apex, bright green and very finely hairy above, paler beneath, with fine hairs only on the nerves. The leaf-margin is dentateserrate.

The small, axillary or terminal racemes rarely carry more than five flowers. Frequently a leaf-axil gives rise to but one fruit, and clusters of more than two are rare, and usually terminal. The calyx is very prominent, the petals obovate in outline, nearly one-half inch long, and light rosy-purple in color.

FRUITS OF REMARKABLE SIZE

The fruits vary from slender oblong to broad oblong, ovoid, or cordiform in shape, and at maturity are one to two and a half inches long, by three quarters of an inch to an inch and a half in greatest breadth. In color they are light crimson, tending to become wine-colored when overripe. They are composed of a large number of relatively small drupelets surrounding a large fleshy, succulent torus which extends nearly to the apex of the aggregate fruit, and at maturity often separates from the drupelets, which cohere loosely inter se. In transverse outline the fruit is often four- or five-angled. At maturity it is rather firm in texture, not as juicy as most of the cultivated blackberries, and of a pleasant subacid flavor (quite acid until the fruit is fully ripe) perhaps suggesting that of the loganberry more than that of the cultivated blackberries.

The receptacle or torus can be eaten along with the drupelets, but when it comes away readily it is often removed before the fruits are eaten (as in the raspberry), and fruits in this condition are often sold in the market.



THE COLOMBIAN BERRY IN VARIOUS STAGES OF MATURITY

This remarkable Giant Blackberry first discovered by Dr. Frank M. Chapman of the American Museum of Natural History on the road between Sibaté and Fusagasugá at an elevation of 10,000 feet in the mountains of Colombia is beyond doubt the largest blackberry yet discovered in the world. It will probably be tender throughout the greater part of the blackberry growing regions of the United States but when the plant breeders of America combine it with the hardy species it may add size and other characters to our commercial varieties. Actual size photograph by Wilson Popenoe, October 1920. (Fig. 2.)

The ripening season is said to extend through practically the entire year but the principal crop matures in October, November and December. The fruits are perhaps more variable in form than those of the cultivated blackberries, and they also vary greatly in size, due probably to environmental conditions more than anything else. I have found the largest ones on soil that is very moist; on poor, dry land they are usually small.

The impression of huge size which one receives when viewing these berries is due not so much to their length, as to the fact that they are broader in relation to their length than is common with cultivated blackberries. The largest specimens I have measured were about two and a quarter inches long, by an inch and a half in breadth. Specimens of such large size are not common, and indeed are rarely seen among the fruits brought into the Bogotá market. I have, however, seen a number of such fruits on the wild plants at El Peñon, produced by canes growing in what could almost be termed a peat-bog.

FLAVOR RESEMBLES LOGANBERRIES

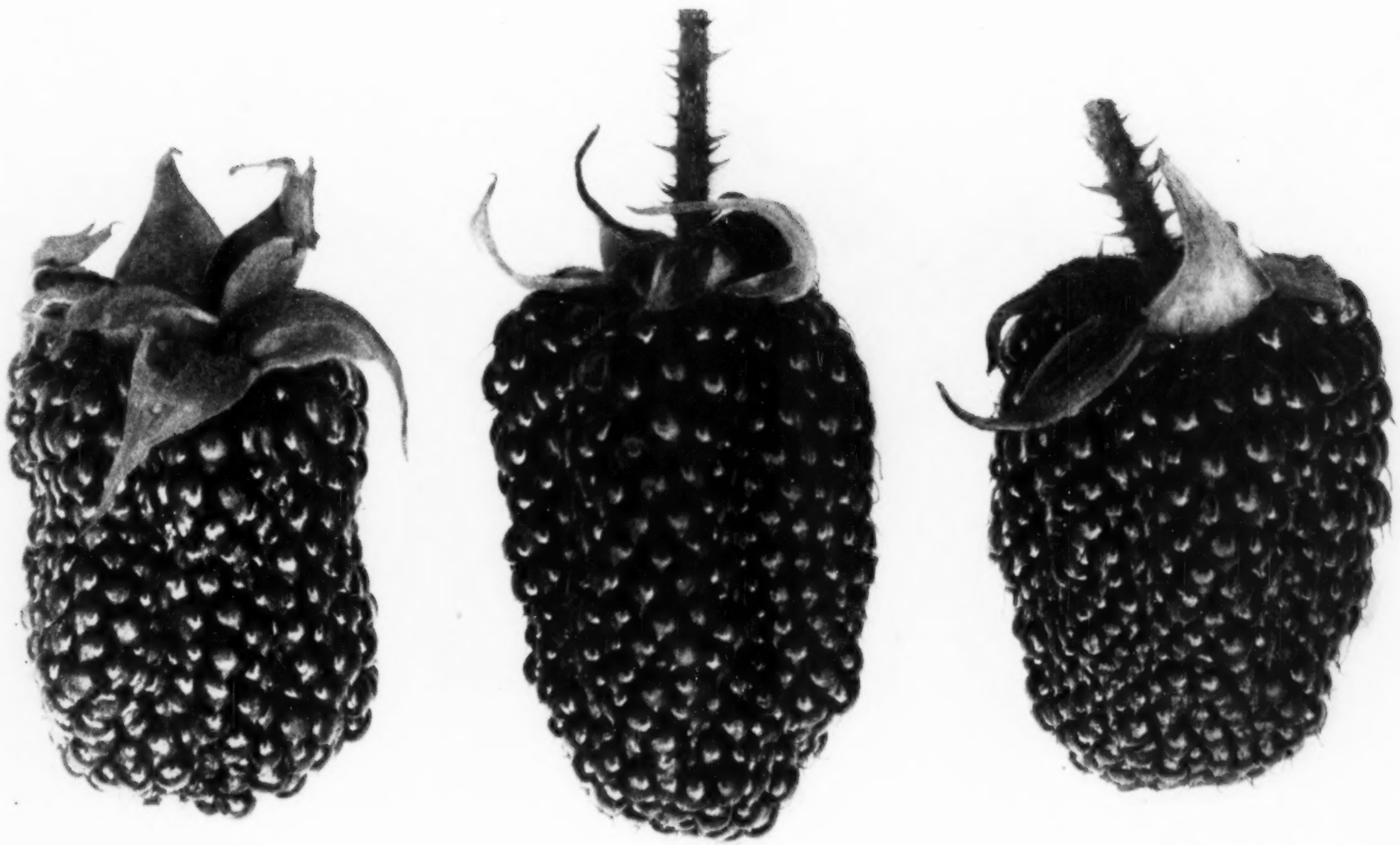
Among Colombians, the fruit is not so popular for eating as that of some of the other wild species of Rubus which also grow in the vicinity of Bogotá. This is due to the fact that there are other species whose fruits are more juicy and less seedy than those of the Giant Blackberry. The latter are, however, brought into the Bogotá market in small quantities, and fetch a good price. They are perhaps better if eaten when fresh, with sugar and cream, than they are when stewed; but it is not common to see them served in this fashion. Usually they are stewed in syrup to form a *dulce* which is served as a dessert. When boiled they become somewhat tough, but they have a rich, delicious flavor resembling that of stewed loganberries.

CULTURAL REQUIREMENTS

Brought into cultivation under favorable climatic environment, it seems reasonable to believe that the Colombian berry will attain much greater size than that reached by fruits borne upon wild plants in the Andes. If it should attain a length of three inches or more, with its proportionate breadth, it would probably stand unique among cultivated species of Rubus so far as size is concerned. Its quality is sufficiently good so that I believe fruit produced by cultivated plants would find a sale in North American markets, where its huge bulk would be certain to attract attention. It will, however, be desirable to improve the species by selection or other methods of plant-breeding: the size of the drupelets in relation to that of the seed may well be increased, the flavor may perhaps be made richer and more aromatic, and the proportionately large size of the torus should certainly be reduced. These are all changes which can probably be effected by means of selection alone. There is, also, the possibility of obtaining valuable new fruits of large size by hybridizing this species with some of the cultivated blackberries or allied species of the genus Rubus. It will be desirable to improve the productiveness of the plant by some means, in order to make its cultivation commercially profitable. Likely, however, much can be done toward this end by proper pruning, an operation of much importance with many members of this genus.

PLANT PREFERS MOIST, COOL CLIMATE

As to the climatic requirements of the plant, it would appear from its occurrence in Colombia in a limited area of particular climatic conditions, that it is exacting in this respect. It is entirely possible, however, that it can be made to succeed under natural conditions considerably different from those of its native home, if given the proper cultural treatment. This can only be determined by experiment. Judging by conditions in the Peñon section, and in general throughout the territory in Cundinamarca in which the plant occurs, one is perhaps justified in predicting that the Puget



ACTUAL SIZE PHOTOGRAPH OF "COLOMBIAN" BERRIES

This wild berry from Colombia is different from every other species. It is appropriate to name it the COLOMBIAN BERRY in honor of the country whose gift it is to the horticulture of the world. It is botanically closely related to *Rubus roseus* described by Geo. M. Darrow. It appears to have no name among the Colombians which is truly distinctive, being called merely *mora*, a term applied in Spanish to the mulberry. It is a giant blackberry although in color its fruits are light crimson tending to become wine red when overripe. The largest are 2¼ inches long by 1½ broad and are often angled in shape. It is not as juicy as most cultivated blackberries, the seeds are rather large, and the core is large but it must not be forgotten that it is a wild form. In flavor it suggests the loganberry. The largest fruits found were produced by bushes growing in what could almost be termed a peat-bog. Photograph by Wilson Popenoe, October 1920. (Fig. 3.)

Sound region is the most likely place for it in the United States. Perhaps, however, the frosts will be too severe for it in that region: temperatures as low as the freezing-point probably never are experienced in the native home of the species. But this does not, of course, prove that it can not withstand any frost. All such matters can be determined only by trial.

It may be taken as evident, I think, that the plant wants a moist soil, and that it prefers a moist, cool climate. It should be tried on the sandy loams of the Gulf States, where it has perhaps a good chance of success, though the climate is hotter in summer and colder in winter than that of its native region.

It should be mentioned, though the inference will already have been made from these notes, that the plant is never cultivated in Colombia, hence no information is available here regarding cultural methods. In the Giant Blackberry of Colombia we have, in fact, a species taken directly from the wild, and possessing, in this condition, far greater economic value than the wild prototypes of many of our cultivated fruits.

NOTE

I cannot refrain from adding this note to Mr. Popenoe's most interesting account of the Colombian berry, for should it or its hybrids ever become valuable fruits in America, the circumstances of its introduction may be of interest to many people.

Upon the return of Colonel Roosevelt's expedition to South America in 1914, the National Geographic Society entertained him in Washington at a dinner party. I was a guest at the dinner and was seated between Dr. Frank M. Chapman and Mr. George K. Cherrie, both of whom had been in Colombia. I affected in my conversation with these explorers to be greatly disappointed over the fact that the Expedition had brought back no seeds or plants of any kind which could be grown in America and become later a living tribute to the sacrifices which the men who formed it had undergone—something which would last long after the stuffed animals had crumbled into dust. In defense of their, to me, indefensible position or for the purpose of making me still more "excited" over the situation, Mr. Cherrie reached across the table and, picking up a small glass, remarked that he and Chapman had seen a blackberry in Colombia, years before, a single fruit of which would fill it. The standing of these scientific men was such that I could not be incredulous, and I proceeded to try to get seeds and photographs of it through correspondence with Dr. Chapman's friend, Mr. Frederick L. Rockwood. Through one cause or another his attempts failed to reveal any blackberry quite large enough to substantiate their stories.

In March, 1918, I met Dr. Chapman and somewhat skeptically asked him to give me again the dimensions of the Giant Blackberry. Dr. Fuertes happened to be present, and, as he had seen the fruit, as well as eaten it, Chapman referred me to him, and immediately he drew for me a pencil sketch from memory of this remarkable blackberry. It was so large that I must confess it taxed my credulity a good deal, and every time I met Chapman I mentioned its incredible size. In June of 1918, Cherrie and I happened to meet again, and to defend himself against my attacks of incredulity, he also drew an outline of his remembrance of the berry. While there is room for discussion still in regard to the actual size of the largest specimen which is to be discovered in Colombia, I think these actual size photographs of Popenoe's, which correspond closely with Cherrie's sketch, but are somewhat under the dimensions given by Chapman and Fuertes, so vindicate the correctness of the Giant Colombian Berry as told by these three eminent scientific explorers as to deserve special mention in connection with this, the first publication of a horticultural account of the species.

David Fairchild
Agricultural Explorer in Charge,
Office of Foreign Seed and Plant Introduction.

A YOUNG COLOMBIAN BERRY BUSH IN ITS NATIVE HOME

This remarkable giant blackberry is found only in a narrow zone at 8,000 to 10,000 feet altitude where the clouds drifting up the Magdalena valley drop their moisture and keep the temperature cool and moist throughout the year. It is a region where bamboos, begonias, and tree ferns luxuriate and approaches more nearly in character the summer climate around the Puget Sound or the Golden Gate than any other in America. The soil on which this bush is growing resembles that of a peat-bog. Photograph by Wilson Popenoe at El Peñon near Sibaté, Dept. of Cundinamarca, Colombia, October, 1920. (Fig. 4.)

ENVIRONMENT AND BREEDING AS FACTORS INFLUENCING MILK PRODUCTION

ANDREW C. MCCANDLISH
Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa

MILK is the one indispensable human food and its consumption has a direct bearing on the welfare of the nation. The problem of the dairy farmer is to furnish milk to meet the needs of the people and at the same time realize a fair profit from it. The demand for milk and dairy products is increasing as the population of this country is increasing more rapidly than is the number of dairy cattle. More dairy cattle are needed, but, what is of even greater importance, better cows are needed. Cows of higher producing ability will not only increase the available supplies of dairy products but they will give more economical production.

EXPERIMENTS WITH SCRUB COWS

In an effort to demonstrate the possibilities of improving a herd of poor cows, work with a scrub herd was undertaken at the Iowa Agricultural Experiment Station in 1907 and is still being pursued. A number of scrub cows were purchased in an isolated region of Arkansas and brought to Iowa.

These animals were very inferior, being as far removed from the ideal dairy type as it is possible to get and were apparently of very low producing capacity. So far as was known no purebred bulls had previously been used in the section from which the animals came. The experimental animals had always been allowed to rustle for a living, being forced to subsist on the rather scant supply of grass and hay available. Nothing was known of their previous milk production as their sole function had been to supply a little milk for family use and to raise their calves until they were able to forage for themselves.

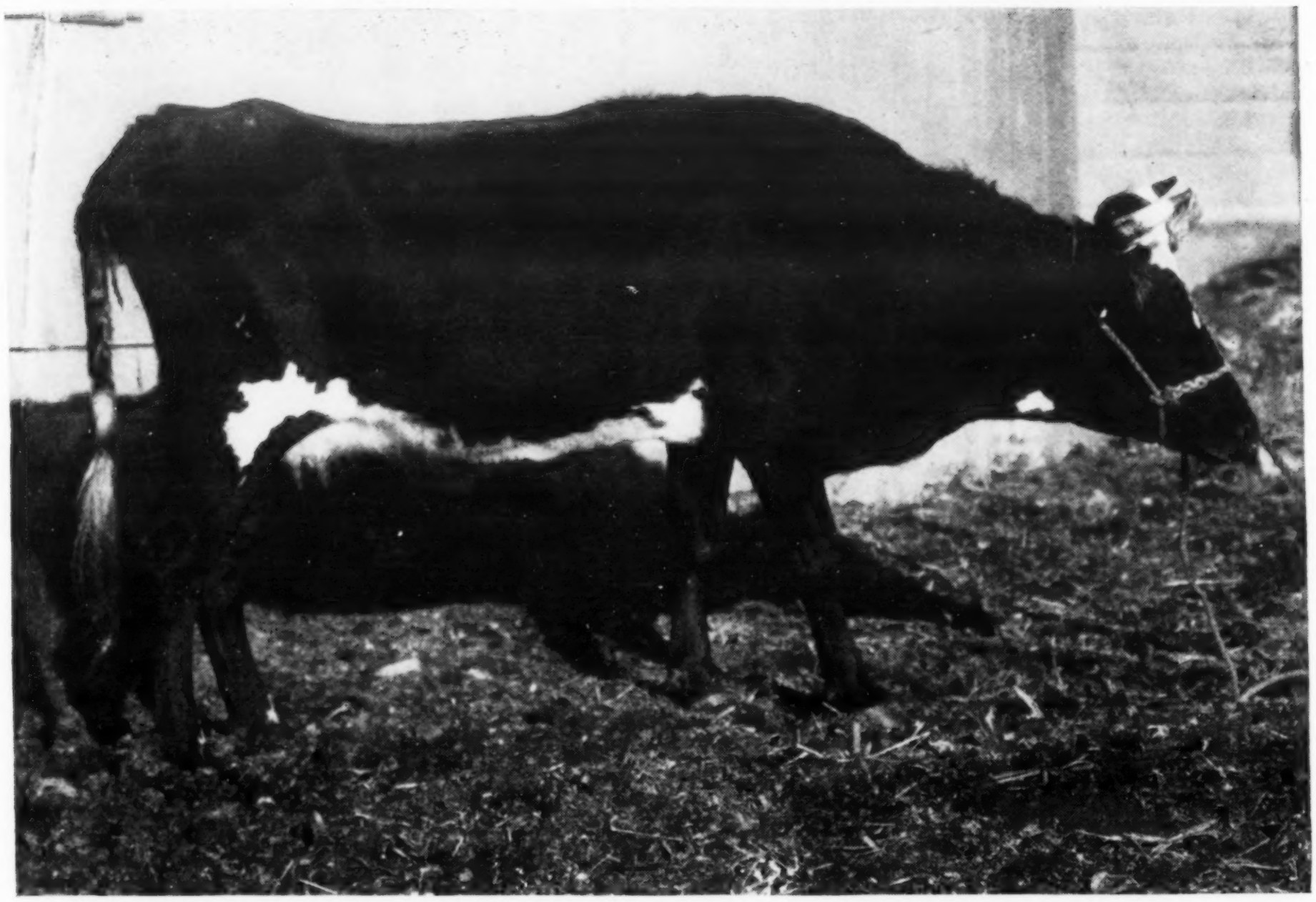
PLAN OF INVESTIGATION

These scrub cows and their heifer calves were put in the Iowa Experiment Station herd and given the same feed and care as the purebred dairy cattle maintained there. The conditions under which the animals have been kept have remained fairly uniform during the twelve years' work.

Accurate records of the milk and butterfat production of these animals have been kept and with their aid the animals have been fed according to their production. The keeping of these records throughout the lifetime of the original animals of the experimental herd gave a basis for the determination of the influence of environment on the production of milk and butterfat.

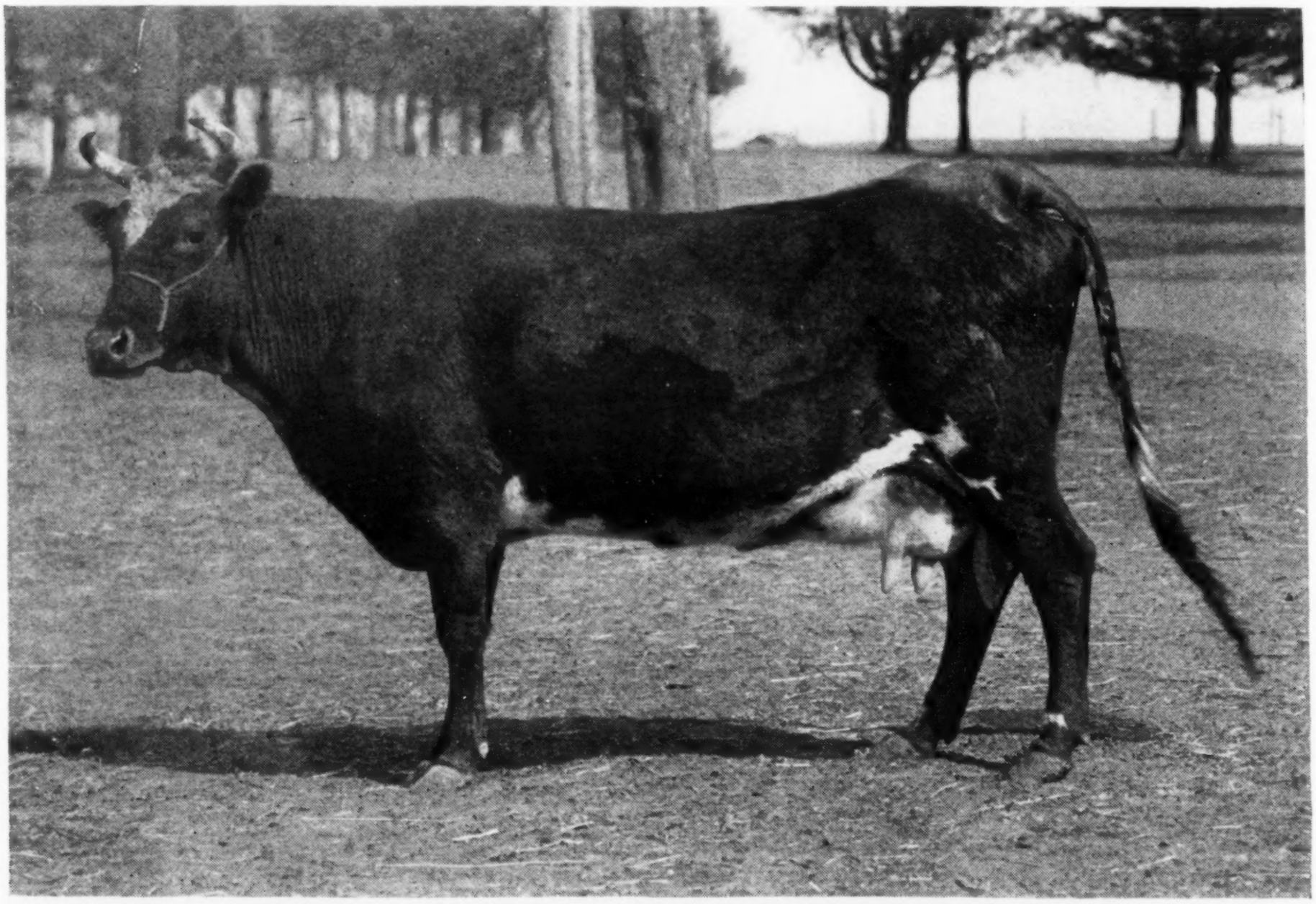
The scrub cows were mated to purebred sires of the Holstein, Guernsey, and Jersey breeds and the heifer calves resulting from such matings were maintained under the same conditions as the other animals. The heifers by purebred sires were bred to other purebred sires of the same breed and the heifer calves resulting from such matings were also kept for dairy purposes. Records are now available on two generations of grades descended from the scrub cows and one animal of the next generation has just entered the milking herd.

In comparing the records made by cows at different ages it is necessary that an age allowance be made as the maturing of a cow has a considerable influence on her producing ability. For this reason all records of the scrub cows and their descendants have to be



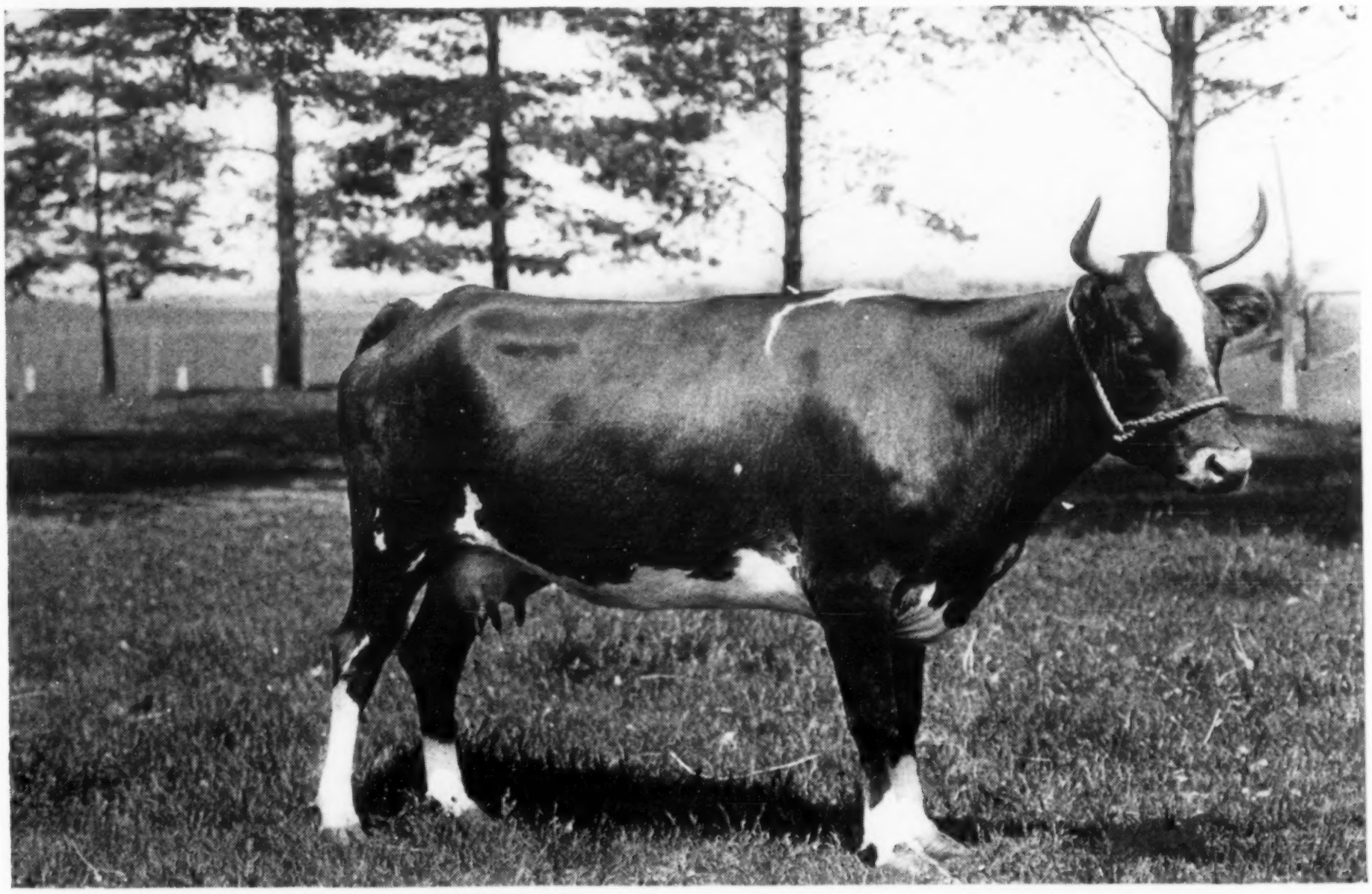
SCRUB COW NO. 6 SHOWING CONDITION AT BEGINNING OF EXPERIMENTS

A specimen of the scrub herd with which the work of improvement was begun at the Iowa Experiment Station in 1907. This cow's record during the first year at the station was 2742.1 pounds of milk and 131.04 pounds of fat. (Fig. 5.)



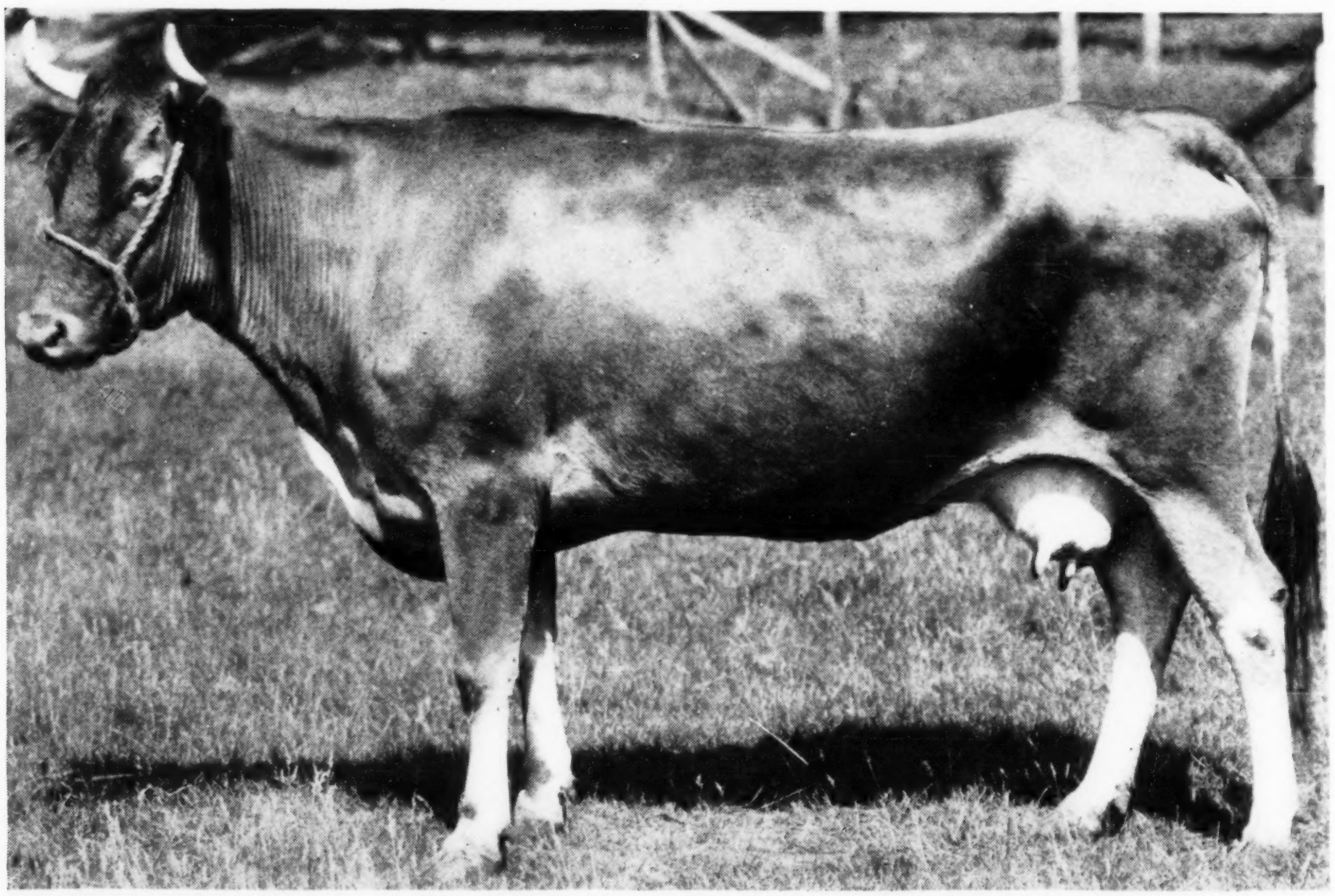
SCRUB COW NO. 6 THREE YEARS LATER

The scrub cows at the Station were given the same feed and care as the purebred dairy cattle there. After three years, this cow produced 5556.7 pounds of milk and 244.79 pounds of fat, an increase over the first year's record of 2814.6 pounds of milk and 113.75 pounds of fat. (Fig. 6.)



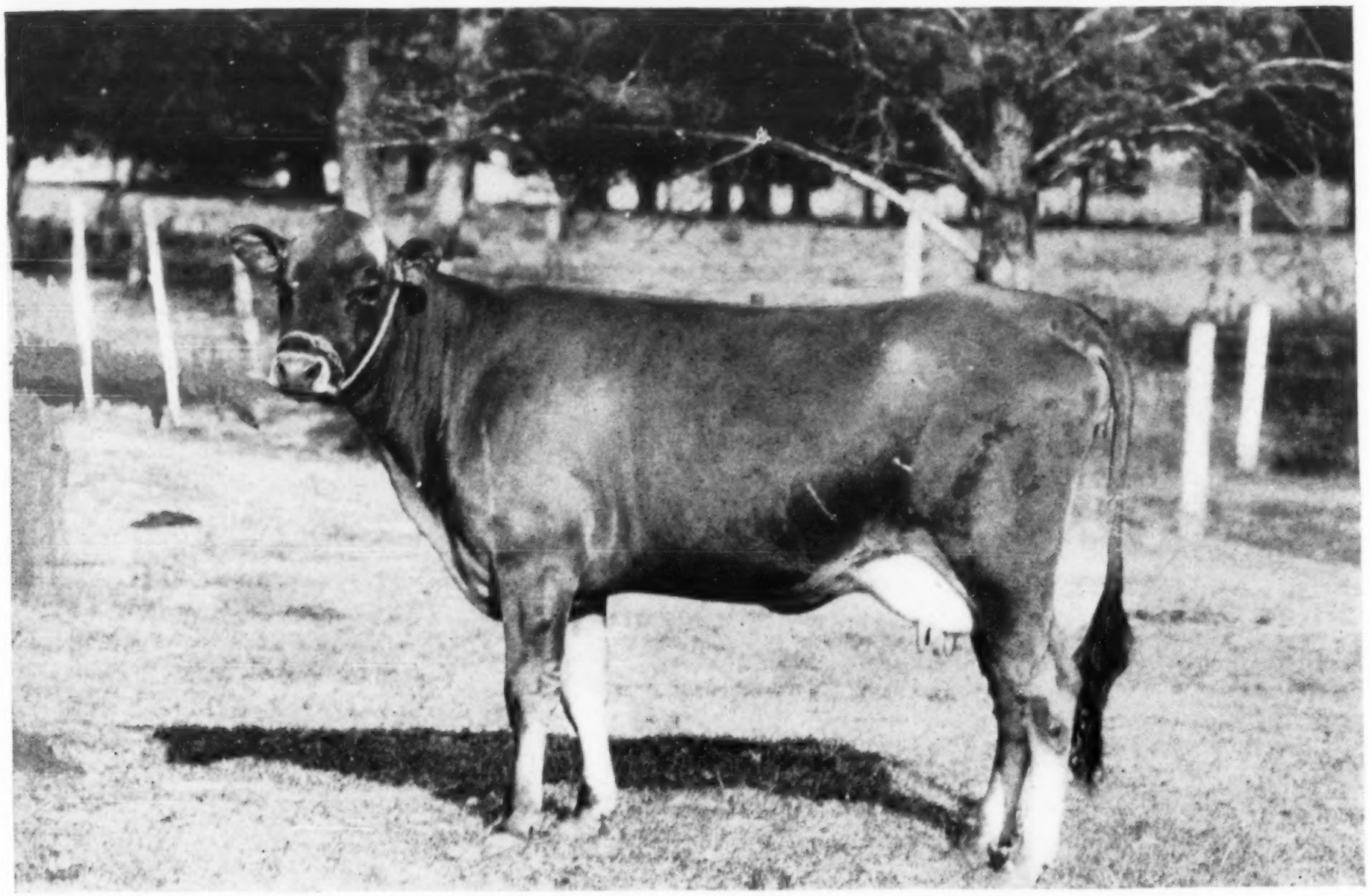
SCRUB COW NO. 60

This cow's average production has been 3313.2 pounds of milk and 178.47 pounds of fat. (Fig. 7.)



A HALF-BLOOD JERSEY, NO. 241, FROM SCRUB COW NO. 60 ABOVE

The record of production from this cow has averaged 6137.9 pounds of milk and 349.42 pounds of fat. (Fig. 8.)



THREE-QUARTER BLOOD JERSEY NO. 348 OUT OF HALF-BLOOD JERSEY NO. 241

This cow's average production is 5366.9 pounds of milk and 278.7 pounds of fat. "The scrub cows were mated to purebred sires of the Holstein, Guernsey and Jersey breeds, and the heifer calves resulting from such matings were maintained under the same conditions as the other animals. The heifers by purebred sires were bred to other purebred sires of the same breed, and the heifer calves resulting from such matings were also kept for dairy purposes." (Fig. 9.)

calculated to the mature basis in accordance with a scale obtained from a study of 10,000 records.

TABLE I.—*Percentage of Mature Production Expected of Immature Heifers*

Age	%
Yearlings	70
Two-year-olds	80
Three-year-olds	85
Four-year-olds	95

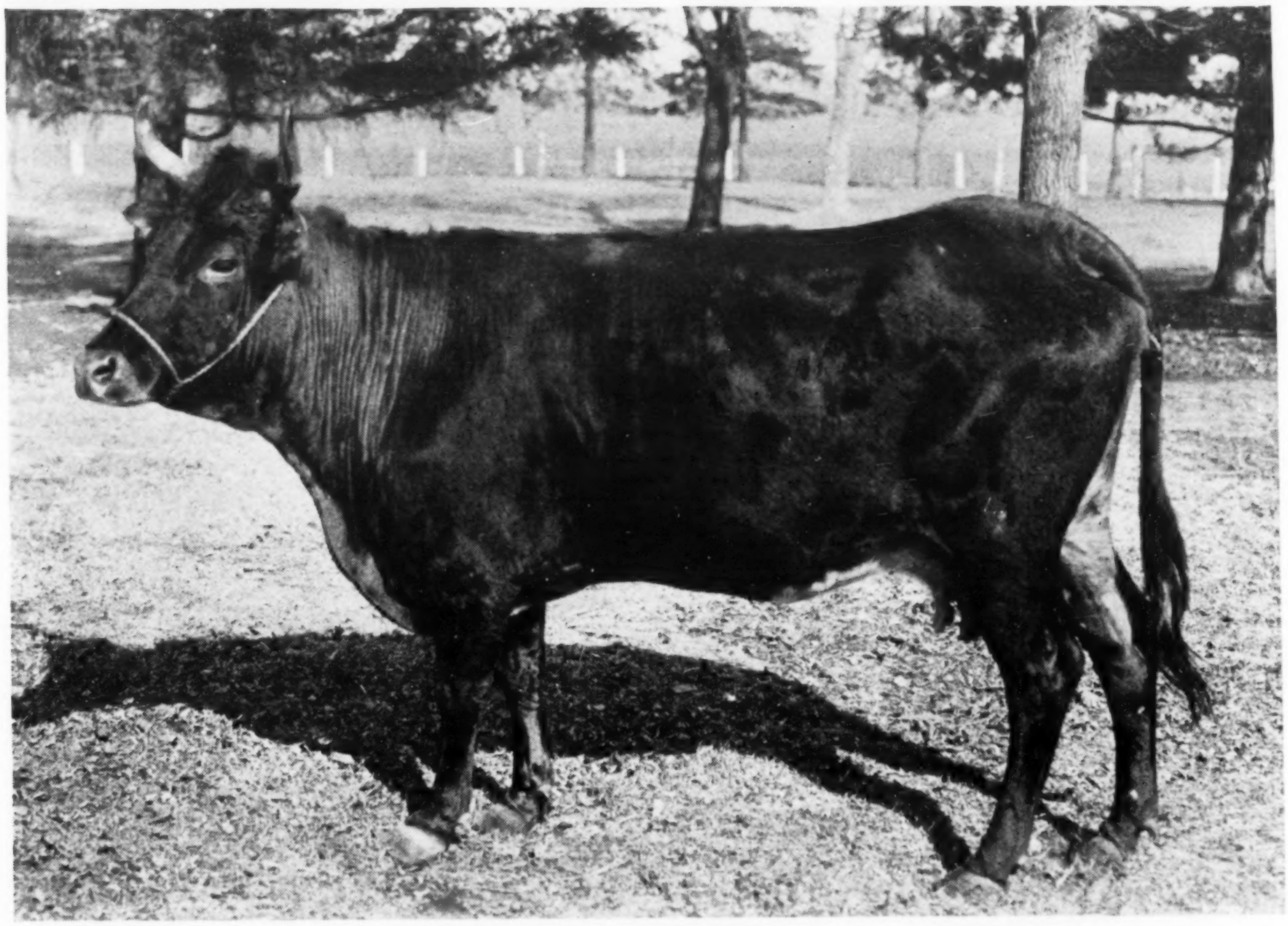
The factors studied in this investigation are of a very varied character and it is necessary that the material relative to each factor be considered separately.

INFLUENCE OF ENVIRONMENT

Of the scrubs that were brought to the station a few were not of producing age, while of those that had reached producing age two were four years old

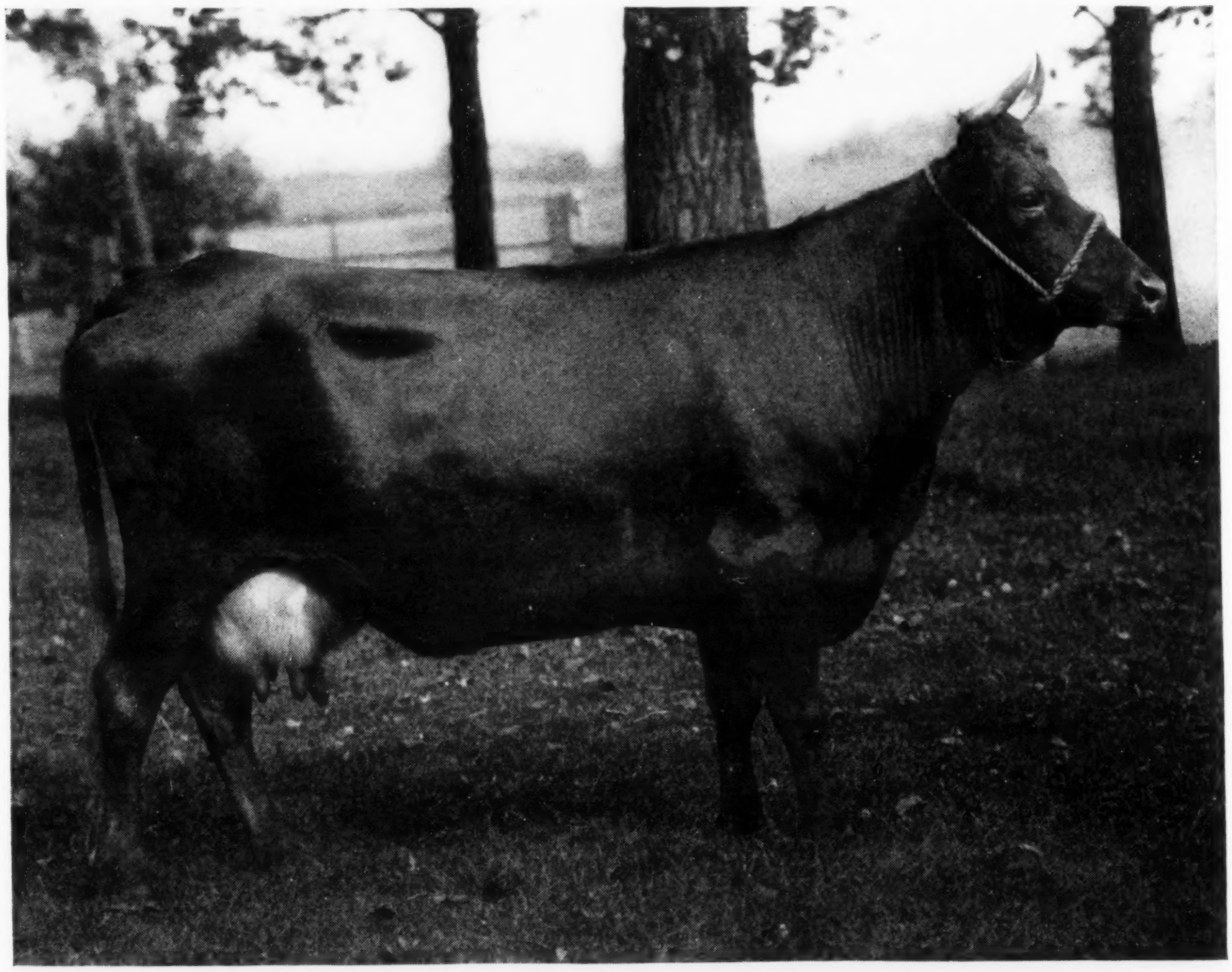
TABLE II: *Production of Cows That Were Four Years Old on Arrival at the Station*

Lactation No.	Age Years	Average Production		Increase in Production			
		Milk lbs.	Fat lbs.	Actual		Expected	
				Milk %	Fat %	Milk %	Fat %
1	4	3084.6	149.24				
2	5	3984.4	178.97	29	19	5	4
3	6	4618.1	217.79	50	46	8	6
4	7	4907.7	229.91	59	54	10	8
5	8	4224.0	197.59	37	32	12	9
6	9	1991.3	84.76	−35	−43	10	7
7	10	2862.5	133.70	−7	−10	9	5
8	11	2296.2	93.83	−26	−36	5	1



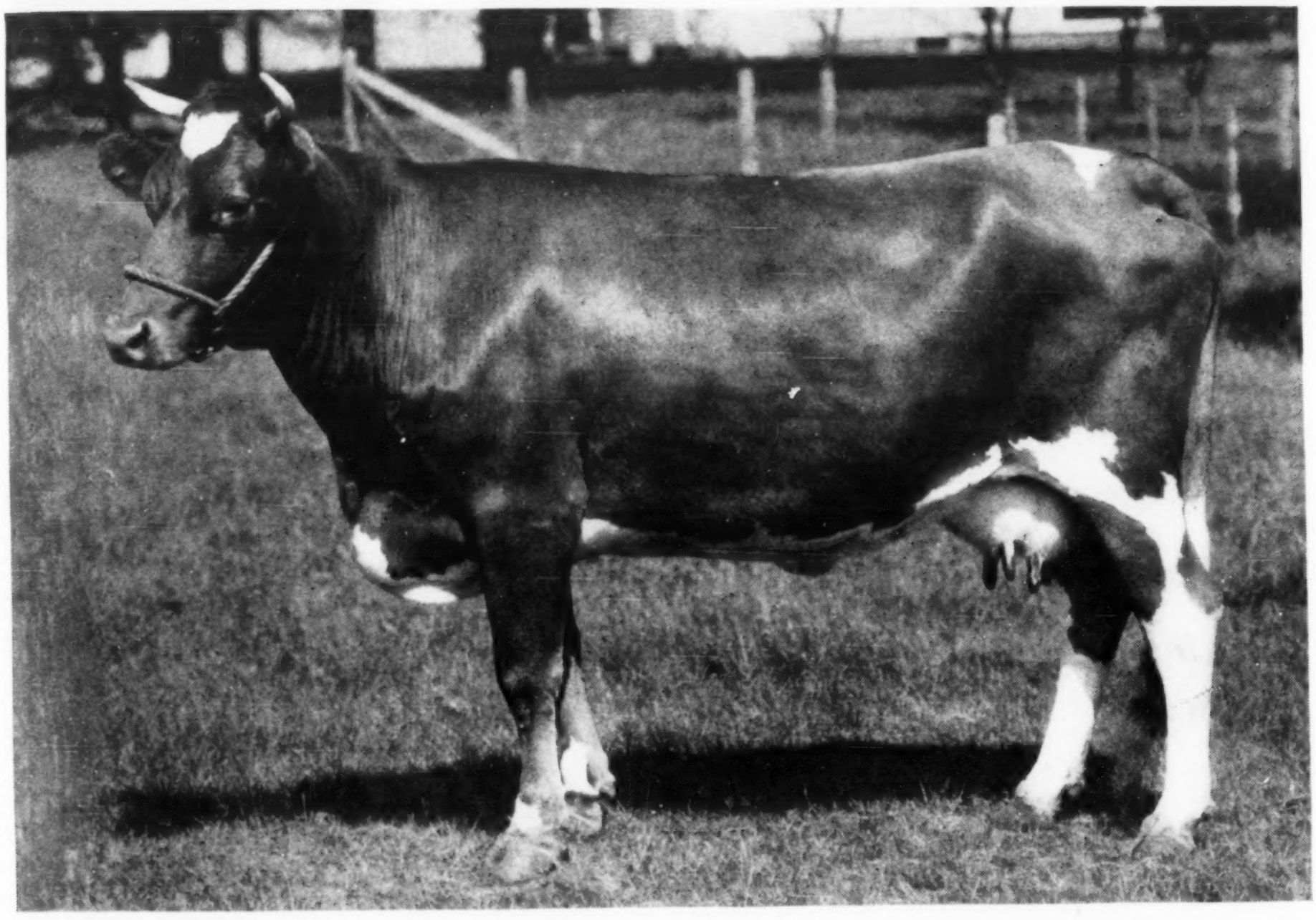
SCRUB COW NO. 33

Average production 4338.5 pounds of milk and 183.49 pounds of fat. (Fig. 10.)



HALF-BLOOD GUERNSEY NO. 87 OUT OF SCRUB COW NO. 33

Average production 4213.1 pounds of milk and 179.72 pounds of fat. (Fig. 11.)



THREE-QUARTER-BLOOD GUERNSEY NO. 236 OUT OF HALF-BLOOD GUERNSEY NO. 87

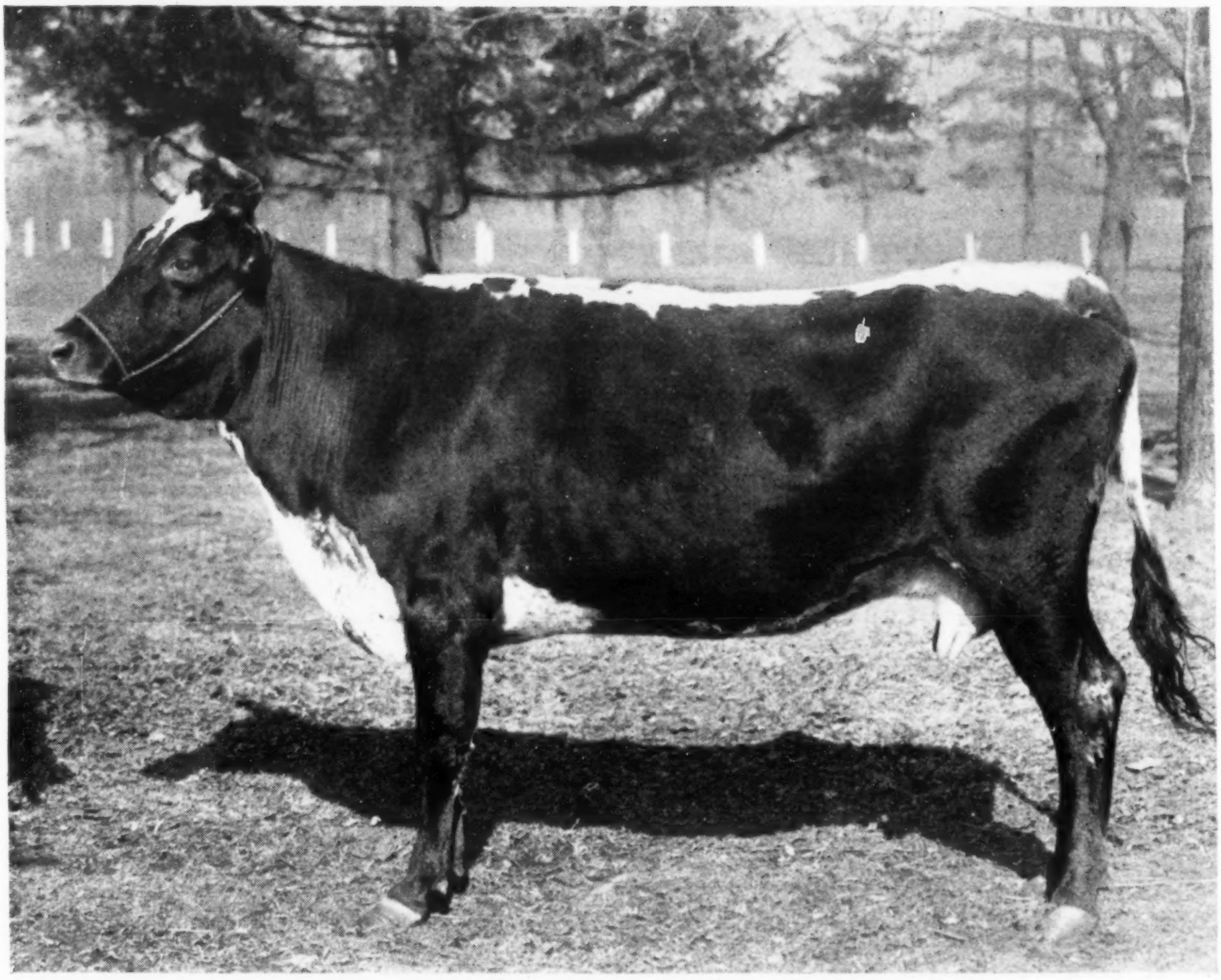
The average production of this cow has been 6345.7 pounds of milk and 320.16 pounds of fat. "Records are now available on two generations of grades descended from the scrub cows, and one animal of the next generation has just entered the milking herd." (Fig. 12.)

and the remainder were mature, that is they were over five years of age. The behavior of those three groups under improved conditions is of interest.

The animals that were four years of age on reaching the station produced an average of 3,804.6 pounds of milk and 149.24 pounds of butterfat during their first lactation period, and with good care and liberal feeding they increased steadily in production until at seven years of age they were yielding 4,907.7 pounds of milk and 229.91 pounds of butterfat, or 59% more milk and 54% more fat than they did during their first year at the station. An increase of only 10% in milk and 8% in fat yield was expected as the result of the maturing of the animals and consequently, the greater portion of the increase secured must be attributed to environmental factors. After seven years of age the decrease in production due to advancing age was quite noticeable—a condition which was expected.

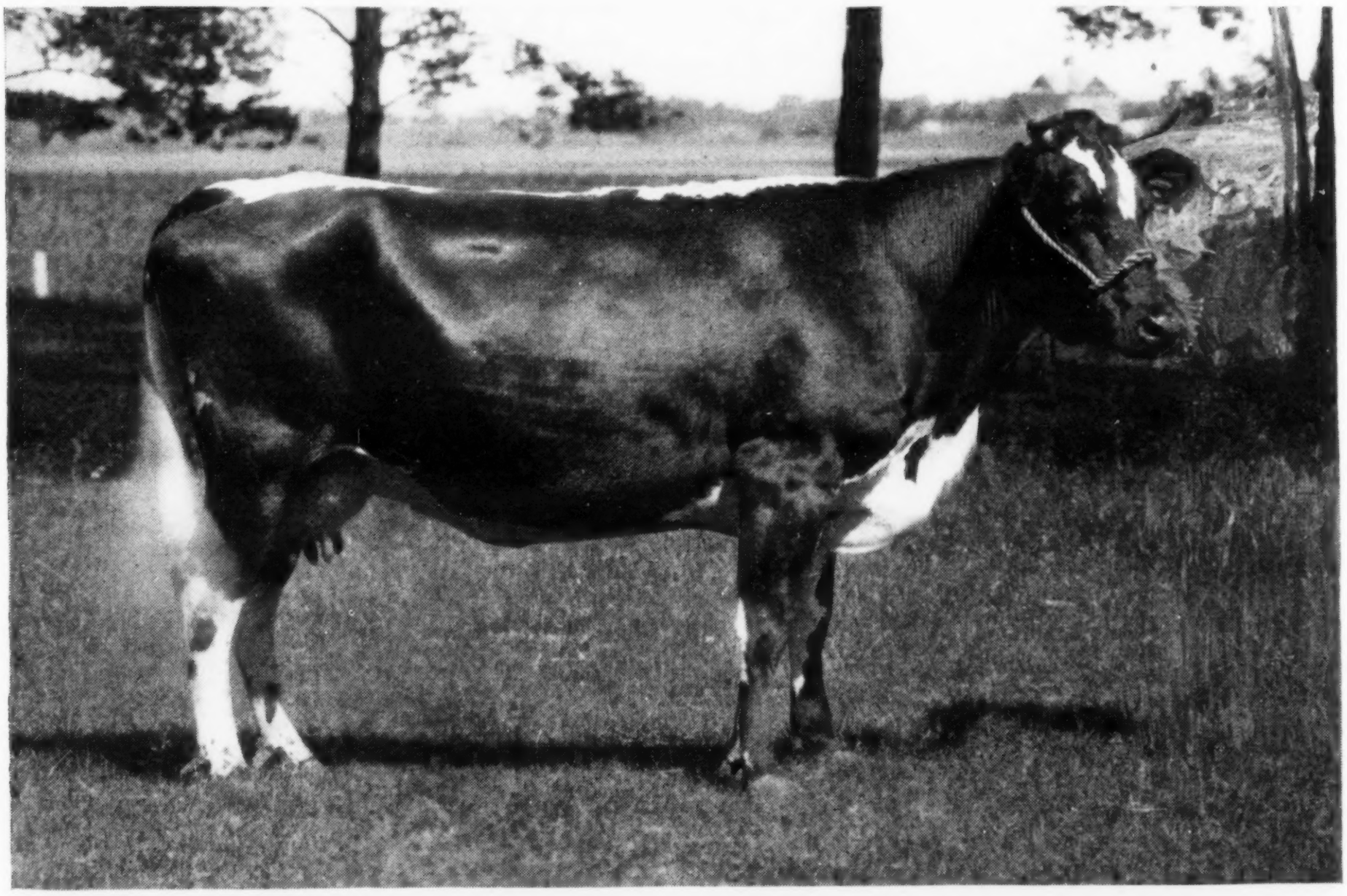
TABLE III: *Production of Cows That Were Mature on Arrival at the Station*

	Average Production		Increase in Production	
Lactation No.	Milk lbs.	Fat lbs.	Milk %	Fat %
1	3790.9	183.84		
2	2874.0	133.50	−24	−27
3	2841.1	141.60	−25	−23



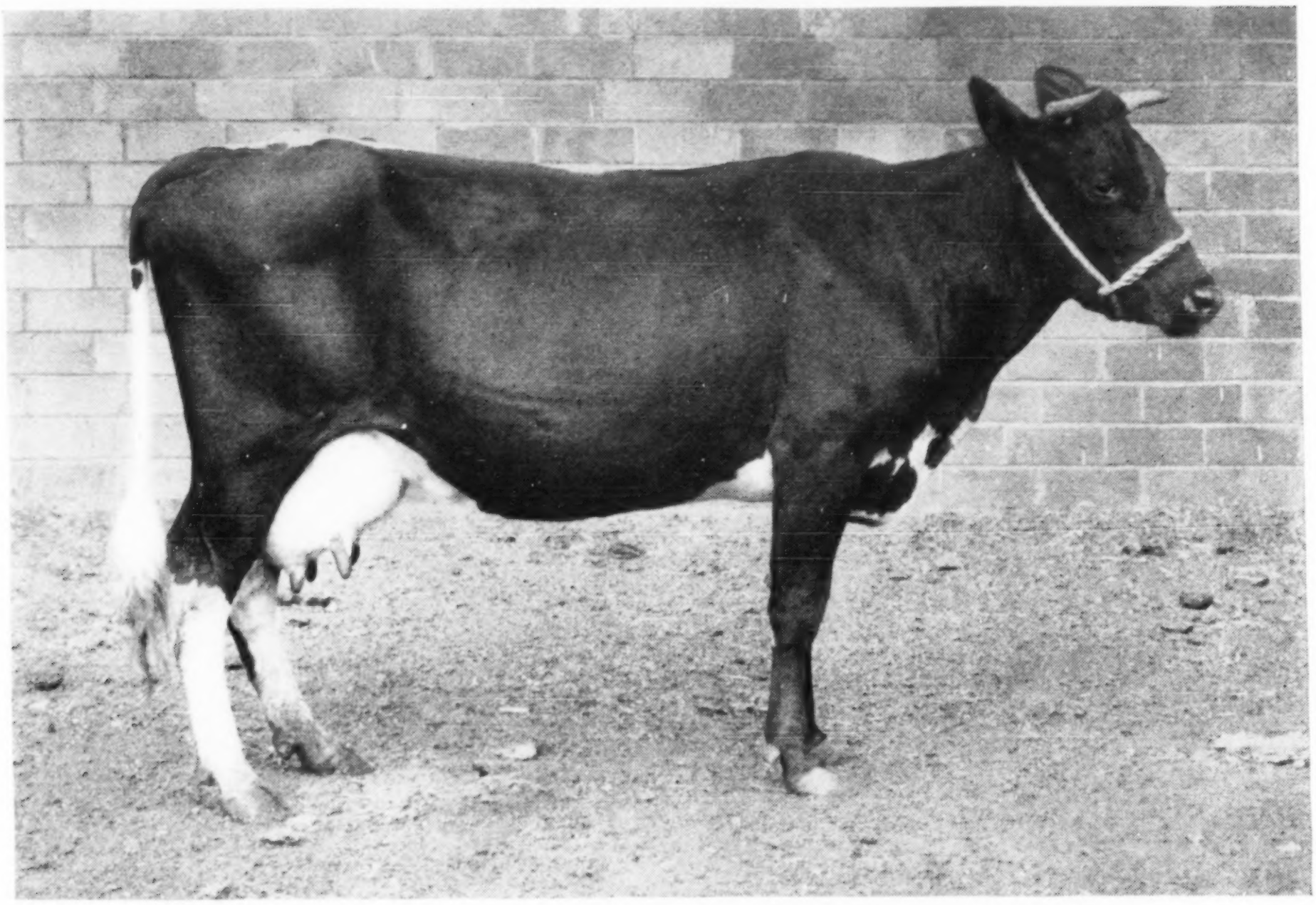
SCRUB COW NO. 56

Average production 3874.6 pounds of milk and 192.62 pounds of fat. (Fig. 13.)



HALF-BLOOD HOLSTEIN NO. 77 OUT OF SCRUB COW NO. 55

Average production 6955.5 pounds of milk and 266.25 pounds of fat. (Fig. 14.)



THREE-QUARTER BLOOD HOLSTEIN NO. 233 OUT OF HALF-BLOOD HOLSTEIN NO. 77

Average production 13366.2 pounds of milk and 497.9 pounds of fat. (Fig. 15.)

TABLE IV: *Average Production of Scrub Cows*

Group	No. of Cows	No. of Lactations	Average Production		Increase in Production	
			Milk lbs.	Fat lbs.	Milk %	Fat %
Mature Cows.....	5	15	3168.7	153.64		
Four-year-olds	2	15	3597.7	166.36	14	8
Heifers.....	7	28	4036.1	191.21	27	24

TABLE V: *Two Generations of Scrubs Compared*

Dams				Daughters				Increase in Production	
		Average Production				Average Production			
Cow No.	No. of Lactations	Milk lbs.	Fat lbs.	Cow No.	No. of Lactations	Milk lbs.	Fat lbs.	Milk %	Fat %
7	3	2366.2	138.20	59	1	3746.9	179.79	58	30
8	3	2339.5	124.35	58	3	3034.5	152.54	30	23
31	7	3463.3	167.95	60	6	3313.2	178.47	−4	6
Aver.	13	2969.3	151.05	..	10	3273.9	170.83	10	13

The cows that had reached maturity before coming to the station all declined in production after their first year even though getting better feed and care than they had been accustomed to previously. It can not be stated, however, that good feed made no improvement in their case as it is undoubtedly true that their records at the station were better than any they previously made under adverse conditions, but they were unable to increase in production during their later years at the station as advancing age brought about a decrease that could not be prevented by good feed and care.

When the scrub cows that came to the station after reaching maturity are compared with those coming at four years of age and those coming before first freshening, it is noticed that those arriving at four years of age produced 14% more milk and 8% more fat, while those coming as heifers produced 27% more milk and 24% more fat than did the older animals. This shows that the younger an animal is when subjected to good treatment the greater is its response.

In other words environmental conditions, or feeding and general care, have a considerable influence on the milk and butterfat production of cows, and the younger animals are when subjected to a certain set of conditions the more readily will they respond.

USE OF SCRUB SIRE

Records are available for three cows and their daughters by a scrub bull, and though this is too limited a number upon which to base definite assertions, certain inferences are justified. Two of the dams were mature on reaching the station while the other was a four year old. Consequently, though the calves received good feed and care from birth, the dams were under favorable conditions for only a limited period of their lives.

The heifers by the scrub bull produced on the average 10% more milk and 13% more fat than did their dams, and considering that these heifers were grown out amid surroundings much more favorable than those which their dams were subjected to at a similar age, it must be assumed that the increase obtained was due, not to the scrub bull but to the feed and care the heifers received.

A scrub bull will sire scrub offspring and no improvement in the production of a herd of milking cows can be obtained where such a sire is at the head of it.

USE OF PURE BRED SIRES

A number of grade animals sired by purebred bulls and descended from the scrub cows have now completed records. These will be studied in two groups—the first generation grades, or those carrying 50% of the blood of one of the recognized dairy breeds, and the second generation grades, or those carrying 75% of the blood of one of those breeds. The only way to determine correctly the value of a bull is to compare the records of his daughters with those of their dams though there are difficulties connected even with

TABLE VI: *Average for First Generation Grades and Their Scrub Dams*

Group	Dams				Daughters				Increase in Production	
	No. of Cows	No. of Lactations	Milk lbs.	Fat lbs.	No. of Cows	No. of Lactations	Milk lbs.	Fat lbs.	Milk %	Fat %
Holstein	4	19	3406.2	168.74	4	18	6444.4	265.92	89	58
Guernsey	6	35	4186.0	189.39	7	20	4899.8	240.96	17	27
Jersey	3	20	4046.7	194.11	3	9	4833.4	265.88	22	34
Average	9	47	3968.6	185.66	14	47	5497.8	255.32	39	37

TABLE VII: *Averages for Two Generations of Grades and Their Scrub Ancestors*

Group	Dams			Daughters			Grand-daughters			Increase in Production					
										1st Generation		2nd Generation			
	No. of Cows	No. of Lactations	Milk lbs.	No. of Cows	No. of Lactations	Fat lbs.	No. of Cows	No. of Lactations	Milk lbs.	Fat lbs.	Milk %	Fat %	Milk %	Fat %	
Holstein	3	16	3673.8	3	15	167.36	5	9	10063.2	385.46	84	65	174	130	
	3	13	4496.6	3	10	199.62	5	8	7744.9	388.23	8	15	72	94	
	2	13	3394.0	2	5	172.52	2	2	5389.2	282.92	61	73	59	64	
Average	7	36	3847.0	8	30	182.40	12	19	8311.4	375.81	55	44	116	106	
Guernsey	3	16	4843.8	3	10	199.62	5	8	7744.9	388.23	60	94	72	94	
Jersey	2	13	5460.5	2	5	172.52	2	2	5389.2	282.92	41	64	59	64	
Average	7	36	5944.7	8	30	182.40	12	19	8311.4	375.81	55	44	116	106	

this method as will be shown later. This method can not be used for the purposes of comparing breeds as all bulls were not given equal opportunities to demonstrate their abilities as sires of producers.

FIRST GENERATION GRADES

All the first generation of grades sired by a purebred Holstein bull showed an increase over their dams in milk and butterfat production. The increase varied from 38% in fat and 79% in milk to 68% in fat and 121% in milk while on the average it was an increase of 89% in milk and 58% in fat.

In the case of the first generation of Guernsey grades an even wider variation was noticed. It varied from a decrease of 31% in milk and 23% in fat, due to the use of a poor bull, to an increase of 107% in milk and 112% in fat yield. The Guernsey first grade group contained animals that showed the greatest increase and also the greatest decrease in fat production from their dams. The average increase in yield was 17% in milk and 27% in butterfat.

The first grade Jerseys showed variations in production as compared with their dams that varied from a decrease of 19% in milk and 3% in fat to an increase of 85% in milk and 96% in butterfat. The average increase in their case was 22% in milk and 34% in fat production.

All of the first generation grades when taken as a group showed an increase of 39% in milk and 37% in fat production as compared with their dams.

SECOND GENERATION GRADES

The grades of the second generation ranked high in production, producing on the average 375.81 lbs. of fat per year as compared with a production of 261.93 lbs. by their first grade dams and 182.40 lbs. by their scrub grand-dams. In every case the production of the second generation grades was at least 50% greater than that of their scrub grand-dams.

The average increase in production for the second generation Holstein

grades as compared to their scrub grand-dams was 174% in milk and 130% in fat; the increase was 72% in milk and 94% in fat in the case of the Guernsey grades; and for the Jersey second grades it was 59% in milk and 64% in fat production.

The average increase in production for the second generation of grades, when all breeds are combined, was 116% in milk and 106% in fat production—a real tribute to the value of the purebred dairy sire.

In the work that has so far been completed at the Iowa Station on the grading up of a scrub herd of milking cows it has been shown that environment and breeding are very important factors in determining the production of dairy cattle. Good feed and care will increase the yields of milk and butterfat but in order that the best results may be obtained from these factors the cattle must be subjected to good treatment early in life. Animals that are poorly fed and stunted during the period of their development will not respond to good feeding when they reach maturity as readily as will individuals which have been liberally fed during the formative period of their lives. The fact that a high average increase in production was obtained in the case of first generation grades and that the second generation of grades produced more than twice as much milk and butterfat as did their scrub grand-dams thoroughly vindicates the use of the purebred dairy sire for the development of high producing cows.

A Text Book of Biology

LABORATORY DIRECTION IN PRINCIPLES OF ANIMAL BIOLOGY, by A. Franklin Shull, with the collaboration of George R. Larue, Alexander G. Ruthven, Peter O. Okkelberg, and others. Pp. 81. New York, McGraw-Hill Book Co., 1919.

Shull's biology is welcome because it treats of the general principles of biology, rather than merely with details of morphology,—although an adequate amount of the latter is included. No text-book can be letter-perfect, but this one includes a large amount of valuable material, with little that is objectionable. Not all geneticists will accept the definition of genetics (p. 239) as a science dealing with the production of minor features of the organism and the laws that govern their occurrence. Heredity is defined (p. 256) as "the occurrence, in the offspring, of the same genes that were in the parents,"—a definition that some will consider narrow. But the general outlines of the book are so good that it is unnecessary to criticise details, which the teacher will deal with according to his own ideas. The text-book is accompanied by a laboratory manual, which ignores genetics as a subject for experimental study.—P. P.

A Conventional View of Anthropology

AN INTRODUCTION TO ANTHROPOLOGY: a general survey of the early history of the human race. By the Rev. E. O. James, B. Litt., F.C.S., vicar of St. Peter's, Limehouse. Pp. 259, price 7/6. London, Macmillan & Co., Ltd., 1919.

All of the conventional ground is covered by Mr. James in this volume. He presents no new points of view, but has been content to gather together time-tried material, mixing it with some rather tenuous speculation about the daily life of our remote ancestors, and coloring it with numerous references to the tenets of orthodox Christianity. The book is not a notable one, but gives in convenient form a lot of material with which the reader or student taking up anthropology must become familiar. It will perhaps be a good introduction to more detailed study, or an interesting piece of reading for one who desires merely a general survey of the field.—P. P.

HEREDITY IN HORSES

Why the Arab Horse Has Shown Such Conspicuous Ability for Endurance in the Recent Long Distance Tests[1]

H. K. BUSH-BROWN
Washington, D. C.

THE recent success of the Arab horse in long distance tests calls the attention of the public, and especially breeders, to the genetic value of the thoroughbred blood.

I use the word here in a general meaning and not as applicable solely to the group of registered race horses known as the "English Thoroughbred." In order to be specific let us state the anatomical differences of recognized types of horses, which perhaps will explain why the Arab is such a good weight carrier and capable of endurance under hardship.

To begin with, the Arab's head is smaller and broader, his nose finer, his eye larger and more prominent and alert. His head is articulated onto the neck at a more obtuse angle than other horses. (See Fig. 16.)

His chest is broad, giving plenty of space for heart and lungs, and his ribs are well set out from the spine, giving a relatively large space for carrying the viscera.

The bones of his legs are clean and very dense as compared with other horses and less liable to defects from hard usage. He stands with all his four feet under him, and with straight hind legs. The osselets are small and the dewlap usually wanting or vestigial.

THE ARAB'S SHORT BACK

These differences are sufficient to mark the Arab as a separate family among horses, but the five lumbar vertebrae instead of the six common to all other horses seem to place him in a separate species. As this difference is now recognized by leading anatomists, it may be of importance to those interested to see some illustrations demonstrating these differences. This shortness in the back is usually in the lumbar vertebrae five instead of six, but it occasionally appears in the dorsal instead.

Figure 17 is a photograph of the five lumbar vertebrae of the pure Arab Stallion Nimr whose sire and dam were only one generation from the desert and whose skeleton is in the Museum of Natural History in New York.

Figure 18 shows the six lumbar vertebrae of the famous thoroughbred horse Lexington whose skeleton is in the National Museum in Washington.

There is here a peculiar atavistic tendency shown in the angle of the spine of the one next to the sacral group, it being thrown backward instead of forward as though it would be one of the sacral vertebrae and thus leave only five in lumbar like the Arab ancestors. This, however, would have made too many sacral.

I have already published[2] a long series of these to show that all other types of horses have twenty-four vertebrae in the back except the Arab which has twenty-three, but it is no longer necessary to convince any one of a fact so well established.

VARIATIONS IN SOME TYPES

The skeleton of the imported Arab stallion Haleb in the National Museum, Washington (not yet mounted), has six lumbar vertebrae but only seventeen dorsal vertebrae, so the shortness of his back is maintained although it is found in the forward section instead of in the lumbar, the usual place for it.

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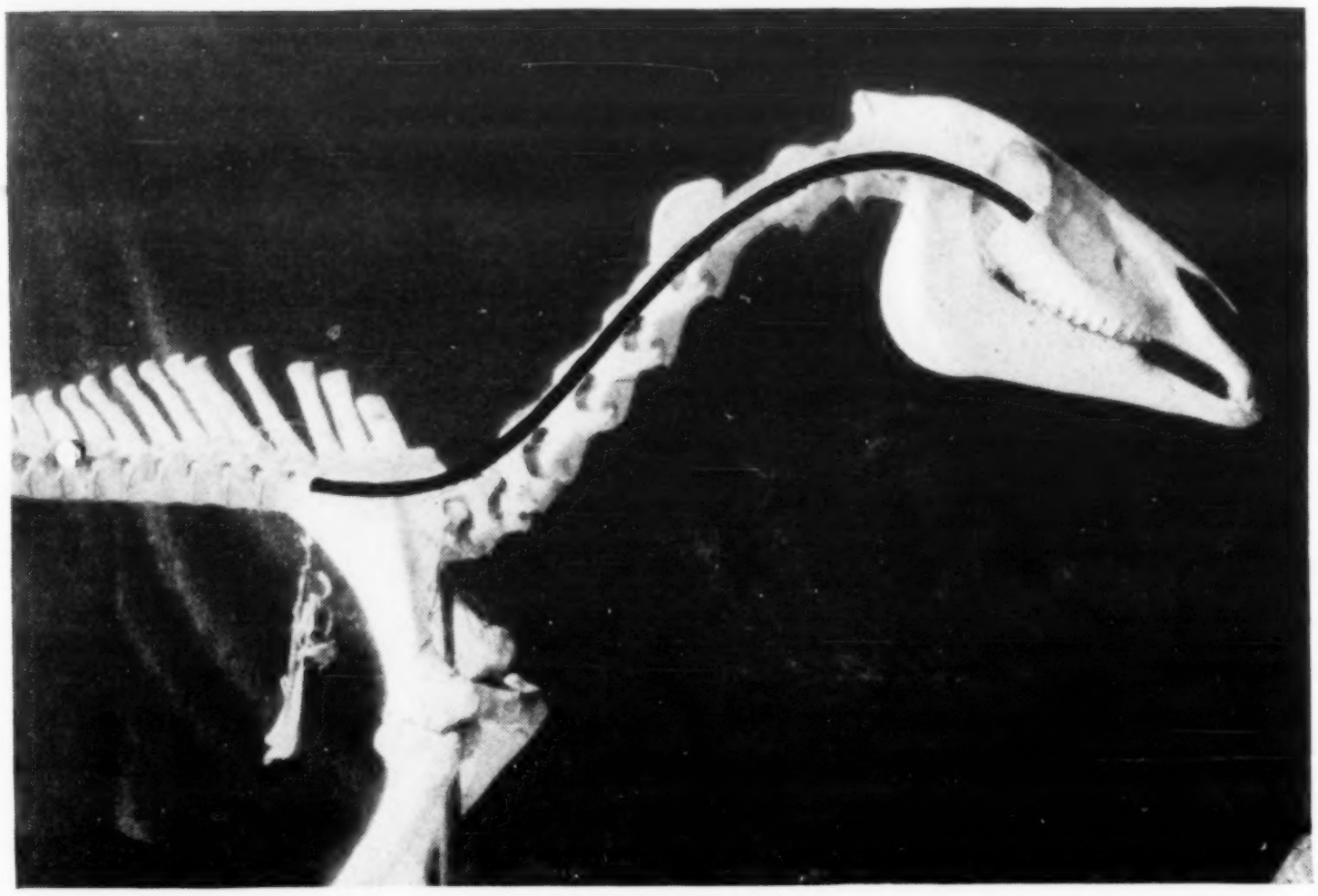
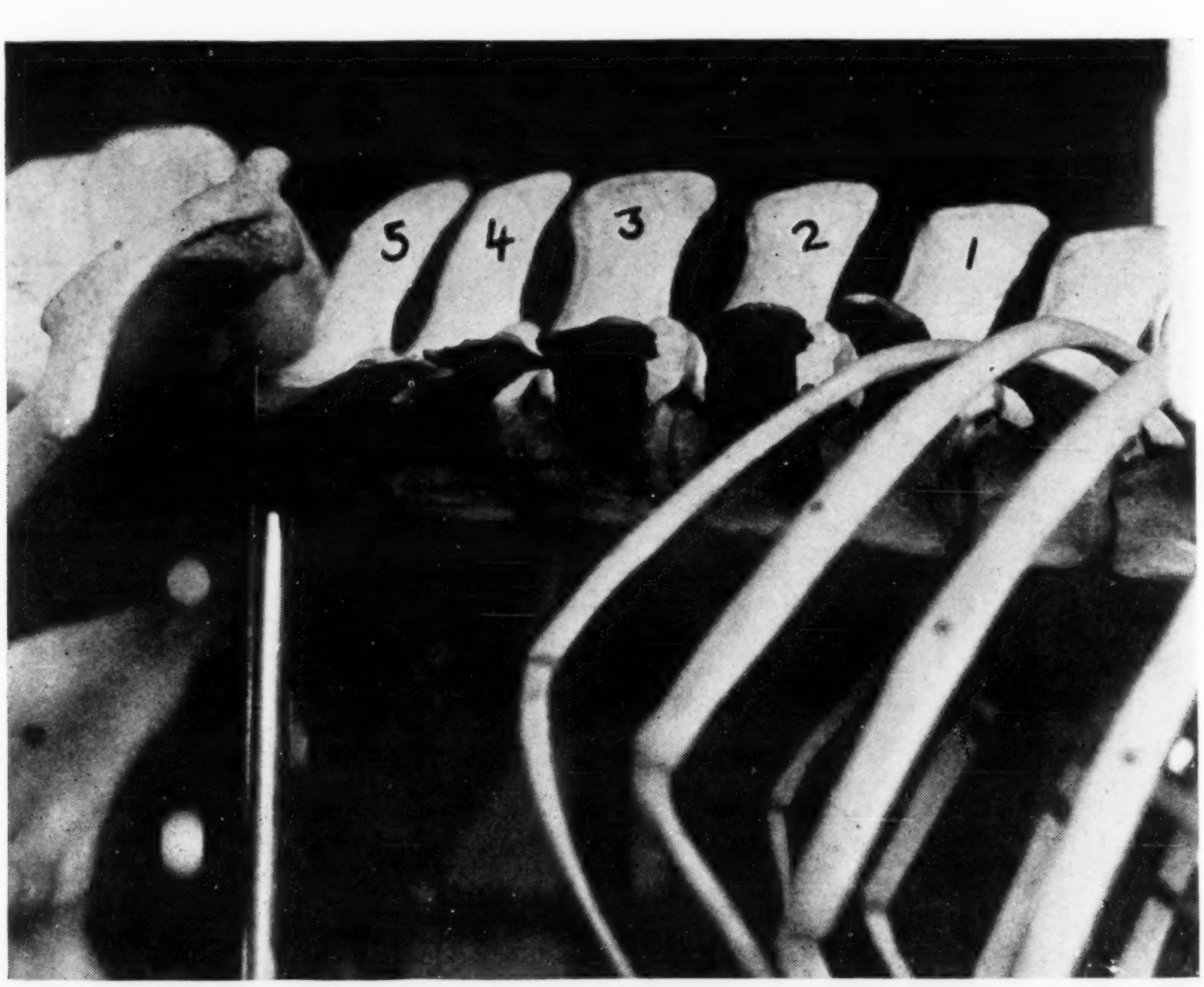
[1] The writer is indebted to Mr. A. H. Chubb of the Museum of Natural History of New York for many courtesies and cooperation. Also to Mr. Warren Delano for his research breeding of Arabs and Norway ponies.

[2] Horses and Horse Breeding, by H. K. Bush-Brown, American Breeders Magazine, Vol. II, Nos. 2 and 3.



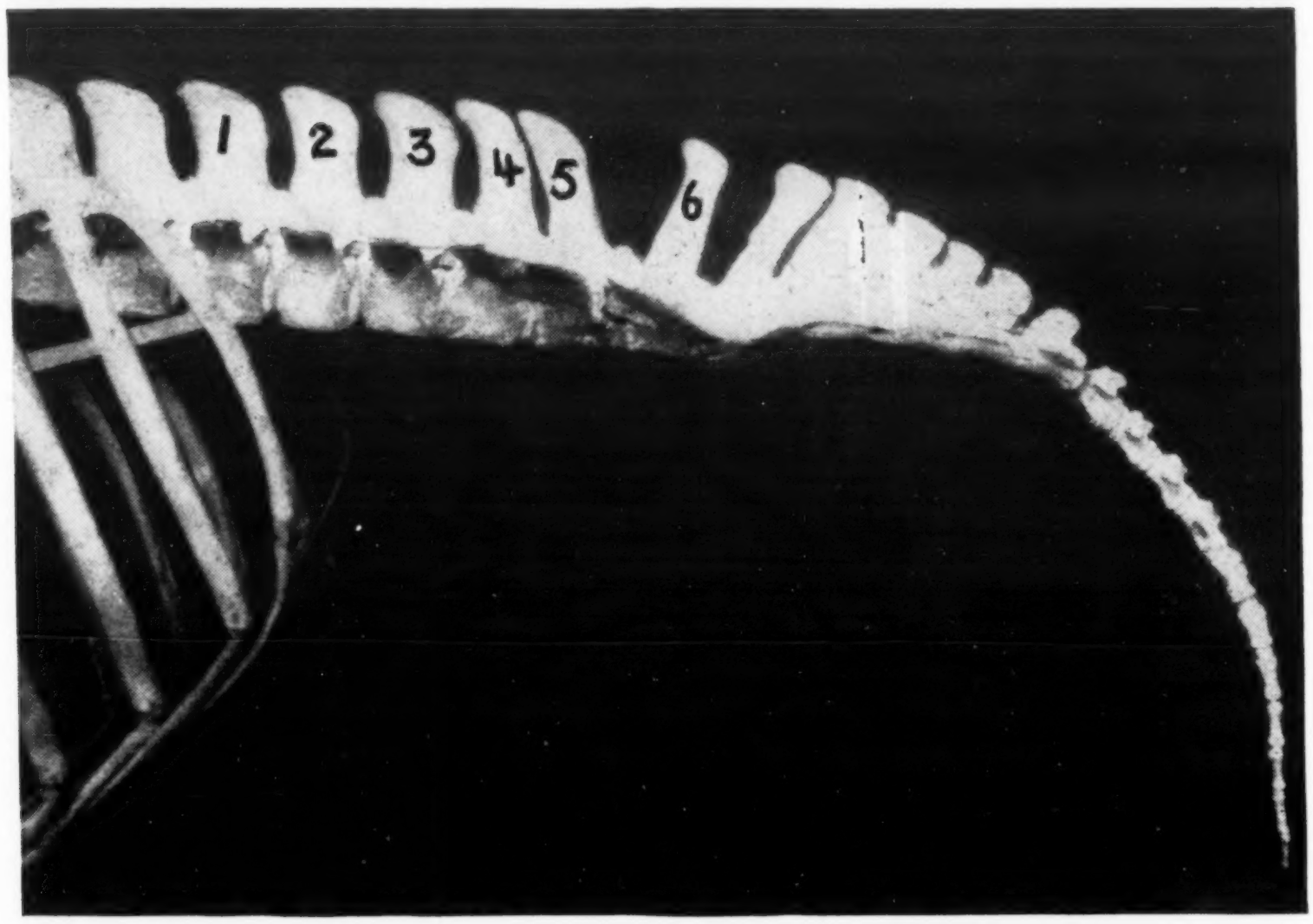
SKELETON OF A PURE ARAB HORSE

Showing the obtuse angle of the head to the line of the neck with "Hogarth's line of beauty" superimposed. This set of the head is recognized by breeders as an essential element of beauty. (Fig. 16.)



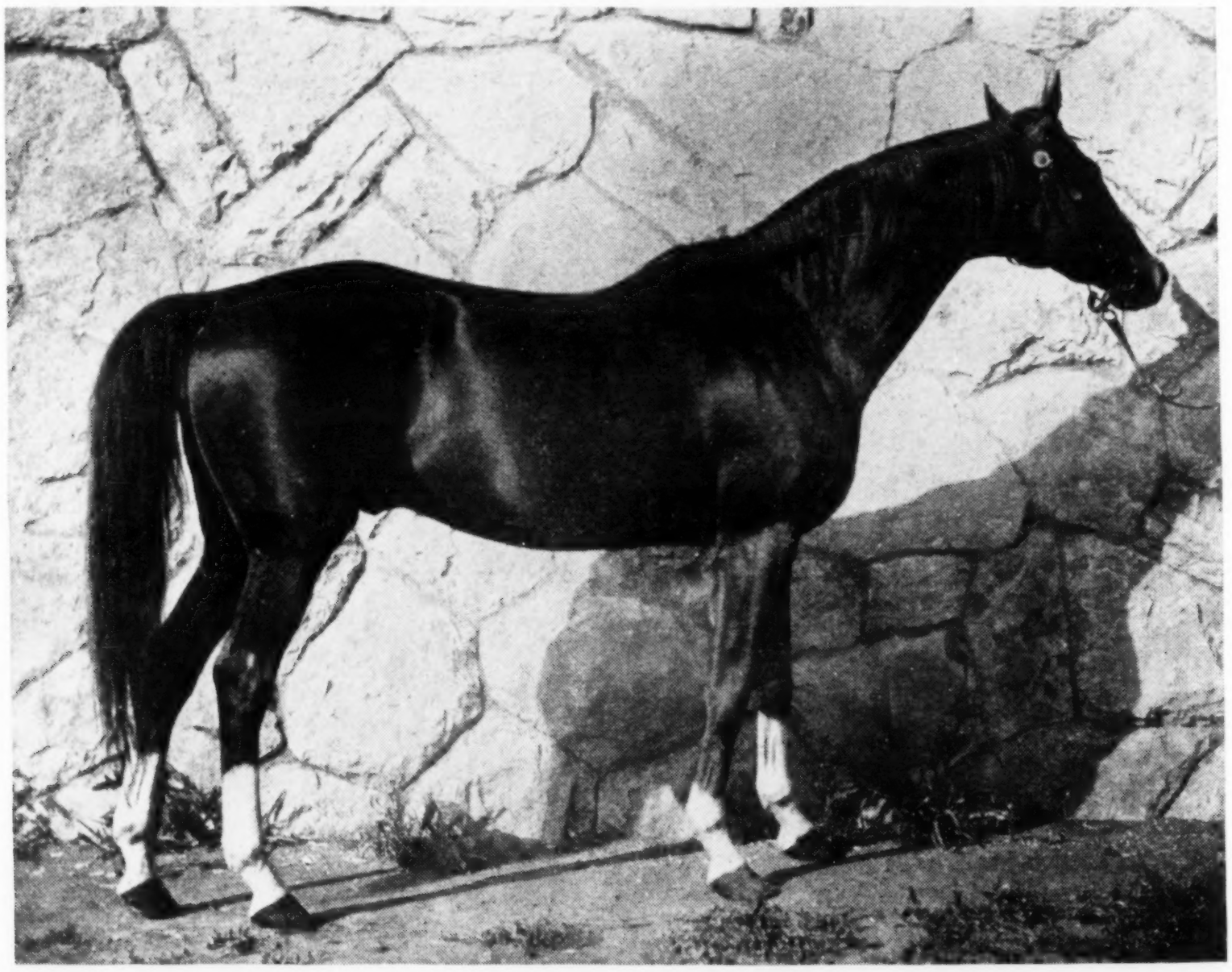
SKELETON OF THE PURE ARAB HORSE "NIME"

The chief difference in the anatomy of the Arab from that of all other horses is that it has but *five* lumbar vertebrae while all other families of the horse have *six*. This difference in structure probably explains why the Arab, though small in size, is capable of carrying great weight and possesses such marvelous endurance. The sire and dam of Nime were only one generation from the desert. The skeleton, reproduced above, is now in the Museum of Natural History, New York. (Fig. 17.)



LUMBAR VERTEBRAE OF "LEXINGTON," THE FAMOUS THOROUGHBRED

The Thoroughbred is a breed of horses descended from the Arab. The skeleton of Lexington, in the National Museum at Washington, shows six lumbar vertebrae. The sixth vertebra inclines backward instead of forward and is reduced in size, and has intermediate characteristics—partly lumbar and partly sacral. This shows an atavistic tendency toward the five vertebrae of the Arab ancestors. (Fig. 18.)



SALVATOR, AN IMPORTED THOROUGHBRED

This racer has a longer back than the Arab. "Hogarth's line of beauty" is shown well in the neck. (Fig. 19.)

THE ASS, LIKE THE ARAB, HAS ONLY FIVE LUMBAR VERTEBRAE

The skeleton reproduced above is that of a hinny whose sire was a stallion with 24 vertebrae (6 lumbar) and whose dam was a jenny with 23 vertebrae (5 lumbar). The fact that this hinny has only five lumbar vertebrae shows the tendency of the dam to dominate the anatomy of the foal in horses. (Fig. 20.)

I am rather insistent on having the dorsal and lumbar vertebrae all counted, not only on account of this Arab specimen in variation from the true type but also because in the Museum of Natural History there is a skeleton of a wild horse of Asia, the Prejevalsky, and also one of a Kiang, each with 19 dorsal and five lumbar vertebrae, making the twenty-four. These are considered merely individual variations, the first lumbar having developed ribs instead of the usual lateral flanges. A superficial observer might class them with the short back of the Arab because of the five lumbars.

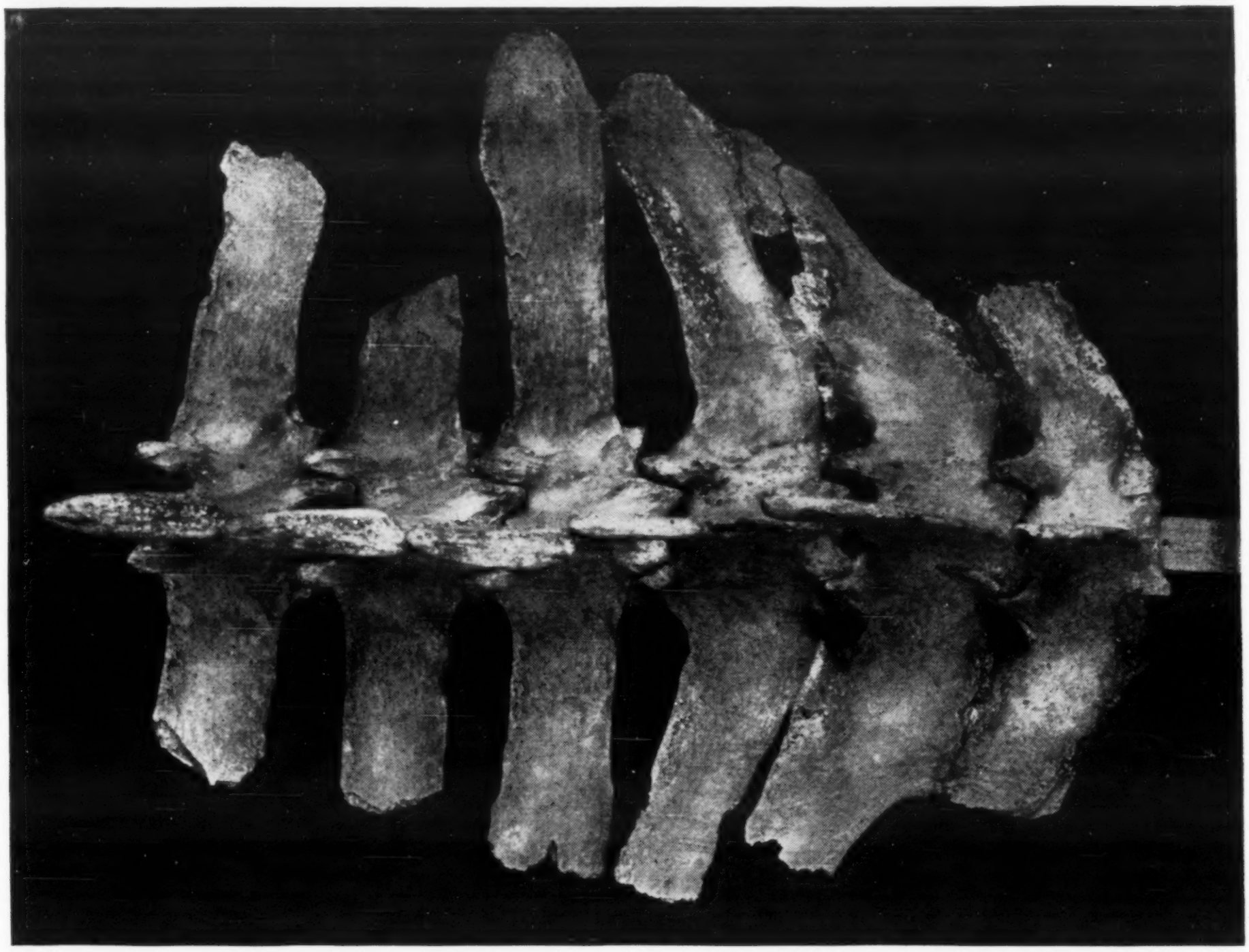
Similar individual variation has been found in a work horse and a Shetland pony, each with nineteen dorsals and six lumbars. Also a Grevy Zebra had eighteen dorsals and seven lumbars.

SHORT BACK A RECESSIVE CHARACTER

As the Thoroughbred, which is practically all of Arab blood as his name indicates, never has the short back of the Arab, so far as I know, it seems evident that the short back is not a dominant character. (See Fig. 19.) I have found it to be dominant only in the first generation of outbreeding when the outbreeding is on the male side. That is a pure Arab mare bred to a trotting stallion produced a foal with five lumbar vertebrae (Museum of Natural History specimen).

The weight carrying capacity of the ass has been known for all time and, he, like the Arab horse, has the short back of five lumbar vertebrae.

A jenney or female ass bred to a stallion produced a hinny which in-



SKELETON OF "OBED"

The sire and dam of Obed (Boaz Clay and Ruth Clay) were each from a pure Arab mare (Naomi) and trotting stallion (Young Jack Shepard). Obed, however, had six instead of five lumbar vertebrae. (Fig. 21.)

herited the five lumbar vertebrae of the dam (see Fig. 20). The sire and dam of Obed were each from a pure Arab mare and trotting stallion, and there seemed a chance that Obed would have five lumbar vertebrae, but he had six (see Fig. 21) with the eighteen dorsals. This shows the recessive character of the short back.

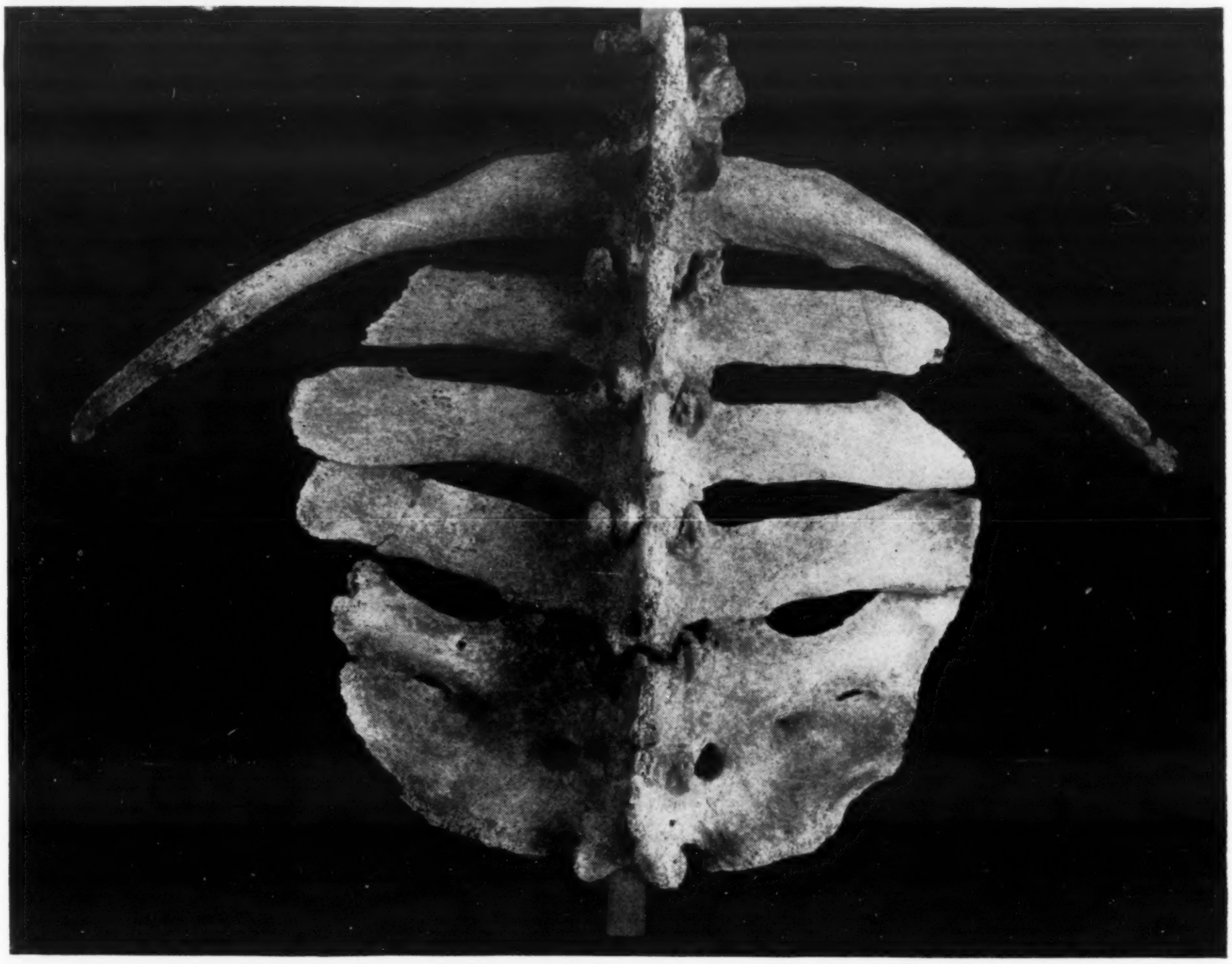
A curious case of atavism is illustrated in the skeleton of McKinney, a trotting stallion, registered number 8818, whose skeleton is in the Museum of Natural History. He was grandson of George Wilkes, and therefore seven generations from the pure Arab Grand Bashaw, his nearest Arab ancestor.

He developed solid ribs on the lateral processes of his first lumbar vertebra. Fig. 22 shows the 17th or last dorsal vertebra, giving his short back of 23 in all, but his solid rib was his 18th, thus having the full 18 ribs. This is important as it explains a like tendency in a foal skeleton from a pure Arab mare and a Norway sire with 17 dorsal and six lumbar vertebrae. (See Figure 23.)

If this foal had lived he would probably have developed two solid ribs like McKinney as he had one rib already attached to his first lumbar, and its mate was probably in process of formation.

McKinney shows by the record that he was a great producer of speed, having sired 31 in the 2:10 class and the dams of 15 in the 2:10 class, while his own record was 2:11¼. His dam was Rose Sprague by Governor Sprague, another great producer.

His anatomy shows he was ribbed up like an Arab with only the width of two fingers between the last rib and the hip



MCKINNEY, A TROTTING STALLION

McKinney was a registered trotting horse No. 8818, seven generations from the pure Arab Grand Bashaw. His skeleton (in the Museum of Natural History, New York) shows the 18th dorsal vertebra and lateral processes of the first lumbar vertebra developed into ribs. (Fig. 22.)

bone. With a saddle on, I believe he could have carried weight and endured long distance. Whether such cases of atavism are common in the trotting horse family I do not know, but in those particular cases they ought to be able to do the work of the Arab. I believe they are very rare. "Nancy Hanks" was apparently of this build.

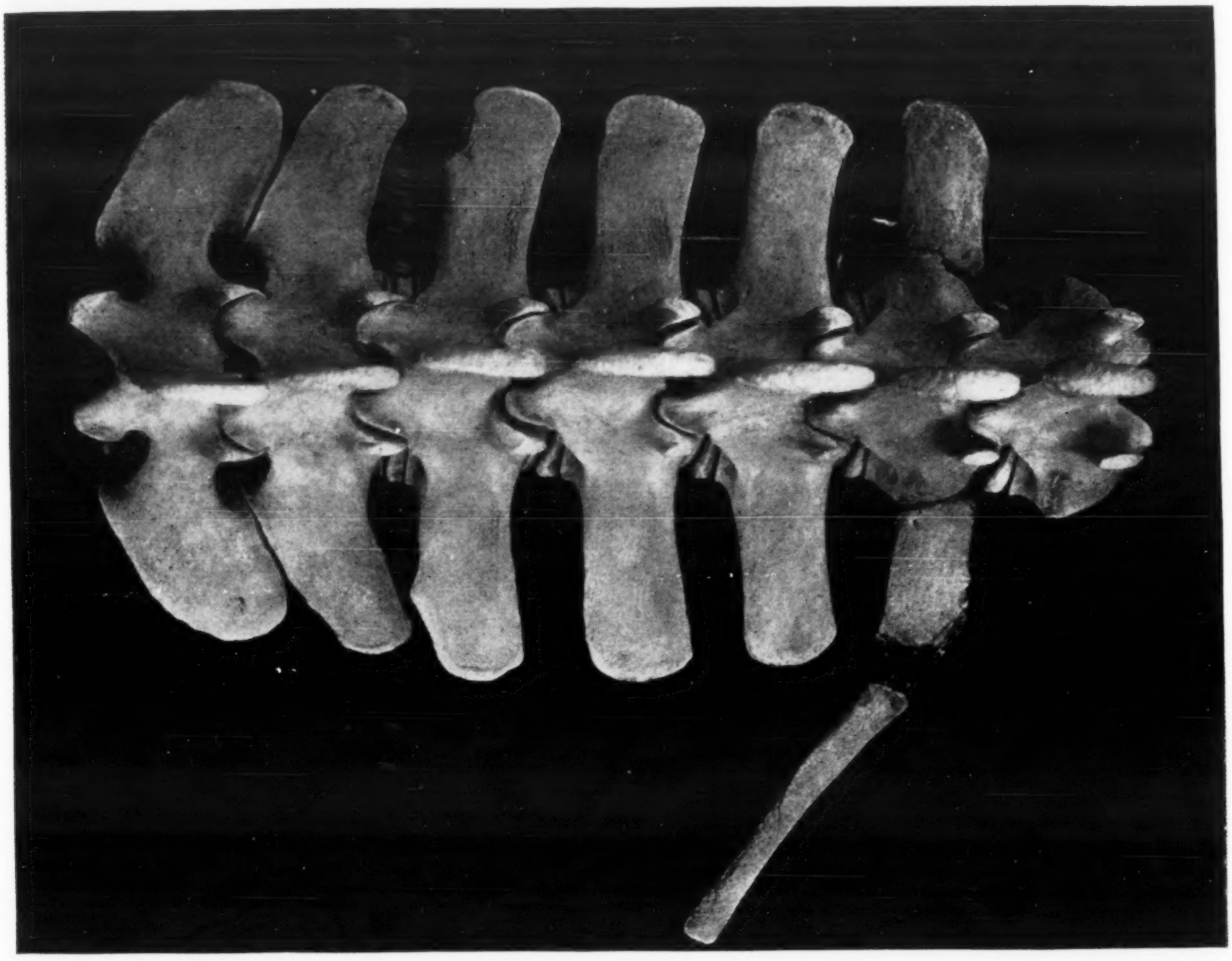
WHY THE ARAB CAN ENDURE LONG TESTS

What do these facts mean to the breeders of horses? Refer to Figures 20 and 23, and one other specimen in the Museum of Natural History. These are three examples of a short back mare being bred to a stallion with 24 vertebrae and the product in each case having the short back of the dam. This seems to indicate the dominance of the dam over the anatomy of the foal.

I think most breeders believe that proportion and anatomy have a relation to speed performance, and if it is so, the above dominance of the dam is borne out by the fact that the successful breeders have paid especial attention to the quality of the dams, and those who have not shown such good judgment have not been successful.

Just why the Arab horse is the best weight carrier among the equines is simply because the bridge of his back is shorter between supports and therefore stronger.

The other anatomical differences mentioned in the first part of this article enable him to carry relatively more food for a long journey and therefore he can endure privation better than a horse who has less "dinner basket" capacity. Consequently it is quite natural for an Arab Horse to win



LUMBAR VERTEBRAE OF A FOAL

A similar tendency to that shown in McKinney in Fig. 7 is illustrated in this skeleton of a foal from a pure Arab mare and a Norway sire. Here is shown the 17th dorsal vertebra and one partly developed rib. The gristle attachment would no doubt have ossified in a short time, and the other floating rib may have been lost in dissecting. (Fig. 23.)

the tests for long distance under service conditions similar to those of the Army, for he is especially built for that purpose.

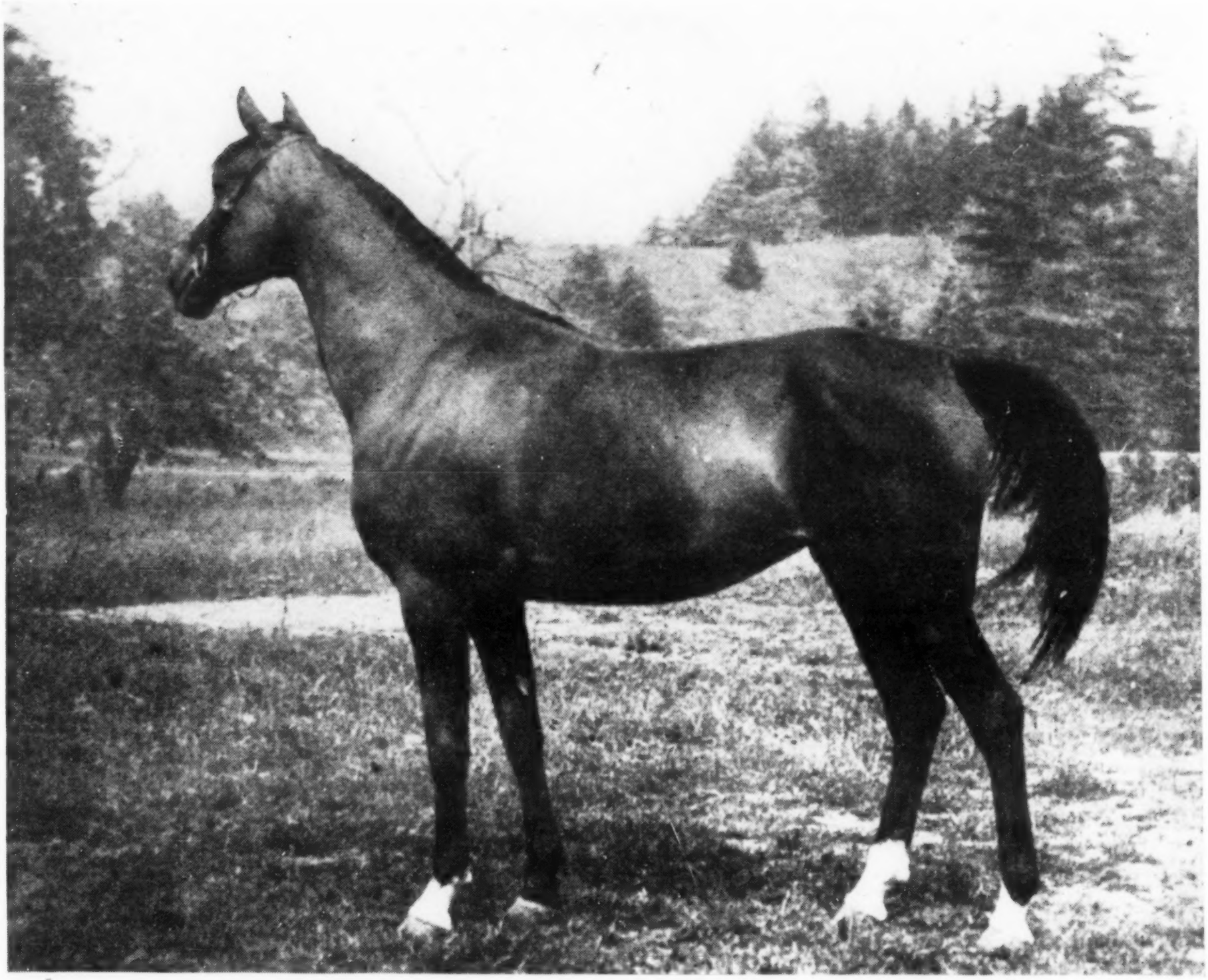
Since the unit character of a short back seems to be recessive except in the purebred Arab, it quite completely explains why the thoroughbred horse is so different anatomically although he is a product of the Arab by long and intelligent breeding, chiefly from male Arab ancestry.

As his name implies he is "*thoroughbred*" from the Arab and yet in no instance that I know of has he developed the twenty-three vertebrae in the back. Therefore to maintain the Arab type, it must be kept scrupulously pure, and this justifies the custom among the Arabs in tracing their horses' pedigrees through the dam.

Of course the power of transmission of inheritance is not confined to the anatomical structure alone. The Thoroughbred is the best horse for a short distance for which he has been especially developed, and he has courage and intelligence perhaps equal to his Arab ancestry.

LAWS OF HEREDITY SHOULD BE CLOSELY STUDIED

The facts here assembled seem to show that the laws of heredity can be pursued with great advantage by a more thorough study of variability in the anatomy of the horse, especially in outbreeding of the pure Arab with the kindred types of different anatomy—a real field for genetic research. This field needs a policy to be pursued by a group of men who can follow the



"RAMLA," THE FIRST TO FINISH LONG DISTANCE TEST

This pure Arab mare completed the 300 mile test in 1919 from Fort Ethan Allen, Vermont, to Camp Devens, Mass., in 57 hours and 26½ minutes, and received the perfect condition mark of 50, and 92.9% for total performance. (Fig. 24.)

research in a well defined way covering a long period of time, and when the older research workers drop out, new men can follow, and so ultimately bring to light a lot of information that can now be seen only obscurely.

If these facts do indeed lead into a comparatively unexplored field, is it not worth while to go further? I would suggest that each year the fastest running horse and the fastest trotting horse be photographed and measured by the system I showed in an article some years ago in the American Breeders Magazine on the proportion of horses.

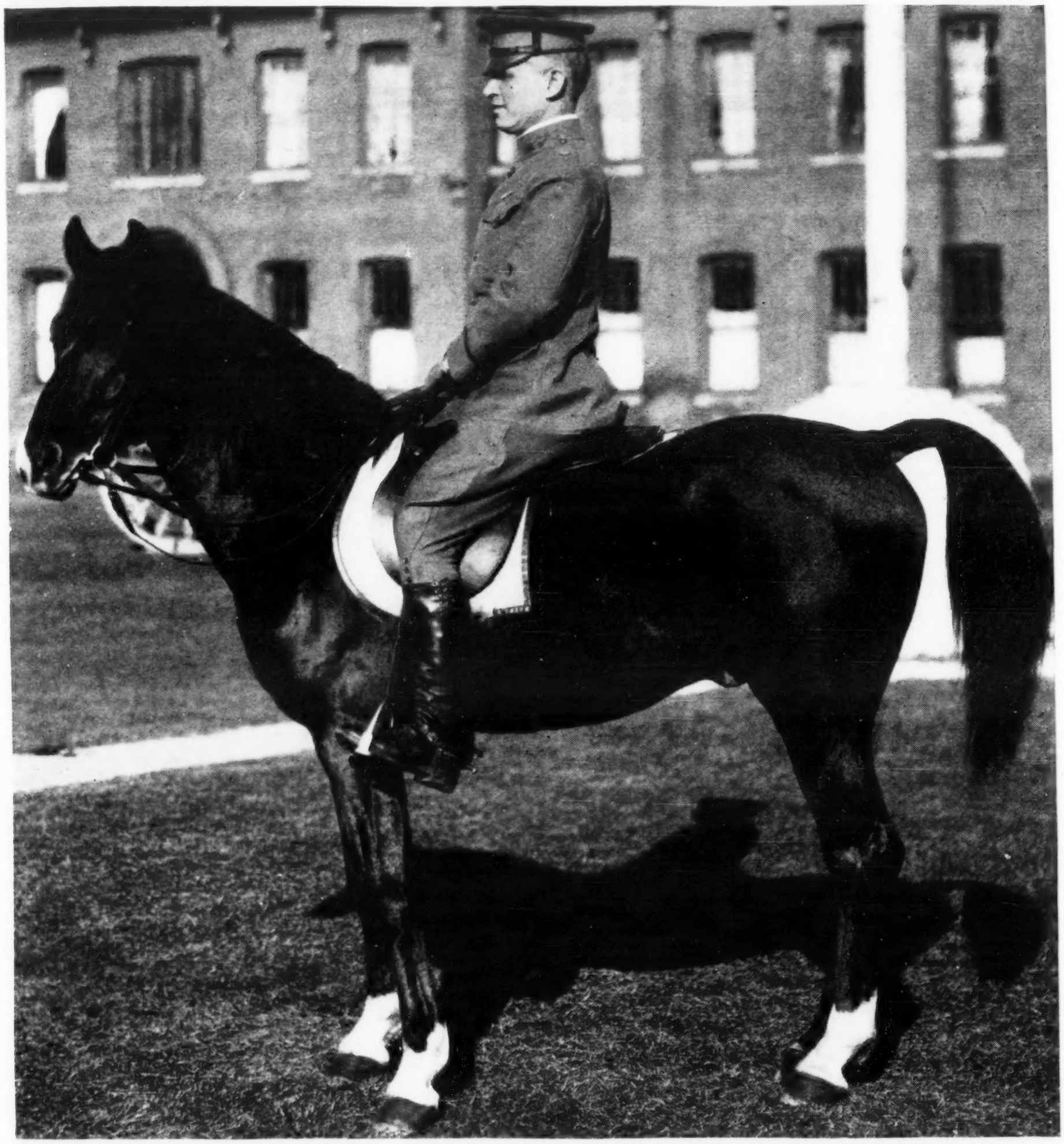
Every best producer of speed of both sexes should be similarly subject to study and at intervals, when a famous horse dies, his skeleton be prepared for study.

These separate types of the horse having specific anatomical differences, give the breeder an opportunity to study the relative influence of the dam and the sire on the anatomy of the offspring.

I know of no other family of mammals where a better opportunity exists, and only by the collection of many specimens can the processes of nature be understood.

If we could establish some more laws of heredity in horses they would be applicable to all mammals to a great extent.

The breeding of small animals for genetic research has been more attractive because the generations require less time for results, and for this reason the horse has been much neglected.



"KINGFISHER," SECOND IN LONG DISTANCE TEST

Kingfisher is three-fourths Arab and one-fourth Thoroughbred. He completed the long distance test in 53 hours and 21 minutes and received the condition mark of 48, and 88.8% for total merit. It was this horse that Col. Tompkins of the U. S. Army rode into Mexico in the expedition in 1916, covering a distance of 575 miles over heated deserts and cold mountains. (Fig. 25.)

FUTURE OF THE HORSE

In spite of the general use of the automobile, the horse has a place in the world, though perhaps a less important one. For long distance travel over ground that wheels can not follow and as a safeguard for the future we must preserve the best of the higher types.

The Arab, more than any other horse has the prepotent power to stamp his good qualities on his descendants for many generations.

So long as the supply of gasoline keeps up we can dispense with many uses of the horse, but if for any reason that supply falls below the needs, or is interrupted, the commerce of the world will be in need of horses beyond the capacity to supply, and the world will recover its horses only slowly.

"KHEYRA," A PURE ARAB MARE

Finishing third in the endurance test; her record was 52 hours and 37 minutes, with a condition mark of 25 and a grade of 72.4% for total performance. (Fig. 26.)

Therefore those who preserve the best types we have are saving for the future the means of regeneration which will save mankind from the disaster that would be, if the oil wells fail to supply all the power the world needs.

THE ARMY DISTANCE TEST

The long distance test from Fort Ethan Allen, Vermont to Camp Devens, Mass., a distance of 300 miles, was ridden between Tuesday, October 14, 1919 and the following Sunday, October 19, the horses doing 60 miles a day for five days, with a quarter mile dash on the sixth day to test condition. There were 14 to start and eight to finish, all in good condition—six sound and two slightly lame. Most of the horses starting the test were: eight Arabs, four Morgans, and two grade thoroughbreds. Those finishing were six Arabs and two Morgans.

In the ¼ mile dash on the sixth day to test fitness, the ¾ bred Arab mare Halcyon (Fig. 27) was first, the Arab mare Kheyra (Fig. 26) second, the Arab mare Ramla (Fig. 24) third, the ⅞ Arab Kingfisher (Fig. 25) fourth, a Morgan "Castor" fifth, and the Arab "Crabbet" sixth.

The performance of this mare "Halcyon" in the whole test is most remarkable as she had weaned her colt only a few weeks before and was again in foal. She is the same mare who won second place in the broad jump in the International tournament for cavalry horses held in Madison Square Garden a few years ago, and was the only American horse to take a prize in that event.

Halcyon is the dam of Kingfisher who was placed second in the Endurance test. Kingfisher, it will be remembered, carried Col. Tompkins

"HALCYON," THREE-FOURTHS GRADE ARAB, CROSS-BRED

Halcyon finished fourth in the long distance test; time 53 hours and 45 minutes, condition 50, and total performance 71.3%. She is the dam of "Kingfisher" who finished second. "Her breeding is a good example of the value of selecting dams with careful judgment." (Fig. 27.)

on his forced chase after Villa from March 15 to April 12, 1916, a distance of 575 miles across the heated desert and over the cold mountains of Mexico, carrying his rider with officer's pack and his own grain rations. His forage was what he could get on a tether at night, and he was in good condition for the three hundred miles that followed.

It is worthy of note that the dam of "Halcyon" was "Heiress" ½ Arab and Thoroughbred, under 15 hands, who won the high jump at the Crystal Palace in London in 1897. Her sire was the famous desert bred Arab "Maiden" who was the unbeaten steeple chase horse of India and after twelve years of campaign in Egypt won many flat races in France.

As "Halcyon" is inbred to this stallion, it was to be expected that she would give a good account of herself when put to a long distance test. Her breeding is a good example of the value of selecting dams with careful judgment.

BEST CONCLUSIONS FAVOR ARAB

I have drawn the conclusions which seem to me to be indicated by the facts from all the data available. It may be that there are not sufficient data on which to base conclusions. I have asked for cooperation from breeders

everywhere in assembling more data covering a long period of time.

This long distance test itself, perhaps some may contend, is not conclusive because the trotting horse was not represented and the thoroughbred represented only by some grade animals. Then, let other tests be given and include long backed horses. If they can stand conditions required for carrying weight long distances, we can change the conclusions after that fact has been established.

The Diamond Ranch of Wyoming has for a generation been breeding the long distance thoroughbred horses and they are known very favorably in the army, but none of them have been in these long distance tests. Similarly the Mustang, or western pony, is known for his weight carrying ability and endurance. Can he make good in these tests, and to what extent has he the short back of his Arab ancestors who were brought to this country by the Spaniards?

NATIONAL INTEREST IN HORSE CONTESTS

Ever since the wild horse was domesticated, that is before man had a written history, the racing of horses was one of the sports of man. The trotting horse race was developed by the American people with its distinctive type of horse that has endeared himself to the heart of man and gone conquering all over the world.

The Army Horse Association was organized for the purpose of making a national sport of the long distance horse test. The country has been divided into fifteen zones so as to have a "horse country" with a 300 mile defined course in each zone. The New England horsemen have adopted zone No. 1 and have ridden it two successive years with marked results.

The way to serve our country in time of peace is to make a national sport of the long distance weight carrying horse and to do it with a scientific spirit of finding out the best types without favor to any one type or man's prejudice. Only in this way can we collect the necessary information of what the type is and where and how to produce it.

By making a sport of this kind of racing, the type will result just as the thoroughbred and the trotter are separate types to fill the needs of two kinds of racing.

THE ARMY TEST OF 1920

Since the preceding part of this article was written the endurance ride of 1920 has been concluded and the results seem to have more than justified what has here been said of the Arab horse.

Five racing Thoroughbreds were carefully prepared at great expense for this ride. One was withdrawn the day before the race. Of the four entered, only one finished, and he was eighth, receiving no money reward and had a condition mark of only 25 out of a possible 50. Five grade Thoroughbreds were entered; two were army mounts, and they finished in first and third positions getting 40 and 35 for condition.

Of Arabs and their derivatives, ten started and five finished. Three were among the money winners, getting second, fourth and fifth places, and one was the only horse to have 50 on condition—a perfect mark. Another tied with a Morgan at 45 on condition—the second highest mark. One purebred Arab made the best time for single days on the fourth and fifth days, namely 60 miles in eight hours flat, and eight hours and a little over, not including a noon stop, beating all records for distance and the weight carried. It was also an Arab that came in first on the last day.

TESTS A FIELD OF SPORTSMANSHIP

It was these facts which justified one of the judges in saying that the Arabs could have taken the first place, if they had not been held back by their sportsman owner who, apparently, wished to give other horses a chance, by which means long distance rides will be encouraged as a national sport.

There were two Standard bred horses in the race and they were dropped on the second and third days.

Of the Thoroughbreds that were out of it, there was one on first day, three on the third day and one on the fourth day and one on the fifth day.

The Morgans did a little better. Of the six entered, two finished in sixth and seventh places. Of those that were dropped for fatigue, one was on the third day and three on the fourth day.

The summary is as follows:

STARTING

Thoroughbreds: 5 registered and 5 grades
Arabs: 5 registered and 5 grades
Morgans: 5 registered and 1 grade
Standard bred trotters: 2

FINISHING

5 Arabs and derivatives, 50 percent of starters
3 Thoroughbreds and derivatives, 33 percent of starters
2 Morgans, 33 percent of starters.

Thus it may be seen, that of the 28 to start, ten finished.

This endurance test goes far to justify the statement that breeding race horses for a fast mile does not produce horses for long distance. Endurance requires a type bred for endurance.

One might as well ask a running horse to trot a fast mile or a trotting horse to run a fast mile as to put these horses in an endurance test to carry two hundred and fifty pounds on their backs sixty miles a day for five days.

Let us make a national sport of this type of endurance horse in the interest of better horses for the army and breed an endurance type.

The first, second and third horses in this contest were of the Hunter type which is well recognized, but some breeders claim it is not a reproducing type. If these contests are continued and horses bred for the type demonstrated to be the best, it can be made reproducing just as the Standard trotters are now a reproducing type derived from Thoroughbred foundation.

A NEW GENETICS JOURNAL

HEREDITAS, a new journal for the publication of original researches in genetics, appears in its first issue under the auspices of the Mendelian Society in Lund, Sweden.

H. Nilsson-Ehle, president of the society, has associated with him on the editorial committee Herman Lundborg, Nils Heribert-Nilsson, and Gustav Thulin. The editor of the journal is Robert Larsson, Adelgatan 7, Lund, Sweden.

Papers will be published in either English, French, or German, and it is expected that three numbers of the journal will be issued yearly to make up a volume of 350 pp. The contents of the first issue follow:

H. NILSSON-EHLE: Über Resistenz gegen Heterodera Schachti bei gewissen Gerstensorten, ihre Vererbungsweise und Bedeutung für die Praxis.—H. LUNDBORG: Hereditary Transmission of Genotypical Deaf-Mutism.—NILS HERIBERT-NILSSON: Zuwachsgeschwindigkeit der Pollenschläuche und gestörte Mendelzahlen bei Oenothera Lamarckiana (With an English summary).—HANS TEDIN: The Inheritance of Flower Colour in Pisum.—EMANUEL BERGMAN: A Family with Hereditary (Genotypical) Tremor.—HANS RASMUSON: Über einige genetische Versuche mit Papaver Rhoeas und Papaver laevigatum.—Å. ÅKERMAN: Speltlike Bud-sports in Common Wheat.—J. RASMUSSON: Mendelnde Chlorophyll-Faktoren bei Allium cepa.

THE MENACE OF THE HALF-MAN

SETH R. HUMPHREY
Boston, Mass.

WHO marries earliest and breeds fastest? Anyone gifted with eyesight and a fair habit of observation knows that, in nine cases out of ten, it is those least capable of providing their offspring with either a heritage of brains or a decent bringing up. The one big fact in the reproductive habits of civilized man is that, in a very general way, the energetic, the brainy, the foreseeing—those who emerge from the commonplace to the level of achievement—have the fewest children, while the improvident and degenerate take as instinctively to reproduction as a duck takes to water, and have altogether too many.

We are populating the earth from the wrong kind of stock. A high English authority asserts that more than half of England's children are produced by the lowest one-sixth of the population; and certainly we in America are doing no better.

Now there is not an intelligent reader of this page who does not know that such a scheme of selection would wreck the quality of any other species of animal or plant. But the mystic teaching of the ages, and our own colossal self-esteem, set us up as a creation just outside the Big Plan. Most of us miss the eternal fact that man is a species, dependent like any other on what he inherits for the qualities which he develops. Meanwhile, Dame Nature is dealing us just the kind of humans that we ought to expect from our manner of producing the most children from the poorer stocks.

THESE FUTURE CITIZENS IN THE SCHOOLS

Suppose we begin at the beginning and follow the output of this system. First, the children appear at the public schools. The public schools used to function badly—they do now in many respects, but they functioned worse before the authorities awoke to the drag imposed on the normal pupils by the growing numbers of the weakminded. So they hit upon the clever scheme of gathering these feebleminded into special classes; experimentally at first, but soon the special class developed into a regular feature of public school work. Now, every sizeable city in the land has its rooms for dullards, in great numbers and rapidly multiplying. Boston alone has seventy-seven rooms in her public schools devoted exclusively to the backward.

We complacently accept the special room as a beneficent device, simply because it permits the schools to run more smoothly. But the special room is mere camouflage thrown over a desperate situation. What sort of citizens can we hope to make of these incompetents?

It seems a harsh thing to say of innocent little boys and girls, but to a very great extent these are society's future jailbirds and prostitutes. Does this jar? An ugly truth usually jars when it crowds against a soothing popular misconception. Proof is to be had, many times over, in the investigations carried on in prisons, reformatories and rescue homes—every one of which has shown from forty to sixty per cent of the inmates to be mentally subnormal. There is a very direct connection between children who cannot develop and grown-ups who cannot behave. This connection is now being brought home with increasing force to every charitable organization which has substituted scientific inquiry for emotional philanthropy.

THE "BORDERLINERS" ESCAPE DETECTION

But the special room is a very small measure of the total number of weakminded children in the public schools.

These youngsters have a way of getting on fairly well with their normal schoolmates until they are near the limit of their mental growth; then they begin to show unmistakable signs of wobbling. A child, for instance, who will never get beyond the mental age of ten can usually manage to keep out of the special room until he is nearly ten years old; it follows, then, that children destined to go through life with mentalities of fourteen or fifteen, get through all the grades and leave school without disclosing their limitations—yet they couldn't have got by a year in the high school to save their lives.

These less obvious of the feeble-minded are the "borderliners," or "morons," as they are technically known—men and women in appalling numbers who stumble along through to old age with just enough wit to escape the foolish house and not enough to connect with the social order. Their shiftiness begins with their first job—they bulk large in the great labor "turnover," so disastrous to industry; they qualify more readily for jails and institutions than for steady effort, and naturally take the easier way. Irresponsibility is their outstanding, lifelong characteristic.

THE GROWING DANGER OF THE "HALF-MAN" IN SOCIETY

Ignorance, as a disturber of social peace, is giving way to education; we are righting injustices which cause turmoil; but the Menace of the Half-man is growing almost unchecked. By instinct they follow any and every designing agitator who happens along. For them, life is one round of spiritless work, rebuffs, hardships, failures and futile beginnings over, such as would kill us normals within a few years. This world, as we now manage it, is run for full-made men and women—that's why it is such a difficult place for grown-up children.

And these are essentially grown-up children. It is all very well to dub them facetiously, "I Won't Work"—some of them deserve it; but when will we learn to read the pathetic message stamped as a birthmark on the crooked features of so many more, "I *Can't* Work"? Precious few humans are born with a distinct inclination for crime, but a sorry lot of them are born every day with too meagre brains to make a living in the paths of virtue. Then why be surprised at their readiness to take up with the forces of disorder? We merely expose our crass ignorance of human nature in one of its rapidly growing phases.

And how they do multiply! Next to their irresponsibility, the chief characteristic of these half-equipped humans is their astonishing fecundity. Evidence of this is so thrust upon the senses of every man or woman who knows the improvident that it needs no further elucidation. The common acceptance is that this grade is increasing at about twice the rate of the normal population; this probably is an underestimate. A western city, recently having rounded up nine hundred of its deserters of families—and habitual desertion of family is a common mark of the half-man—discovered that they had abandoned forty-seven hundred children, not to mention those they had left along the trails of their wanderings. This is an average of more than five children each. From observation of human nature in general it is safe to say that nine hundred of the most progressive families in that western city could not muster an average of two children each. Five from the worst stocks, against two from the best—this is a condition that holds in a general way for our whole population.

INCOMPETENTS INCREASE DEMAND ON CHARITY

No wonder that we have had to develop such enormous corrective and philanthropic machinery everywhere. This sort of people is doubling on our hands with every generation. The number of charitable organizations in New York City runs into four figures; they are counted by hundreds in every other large center of population. Charities originally were supposed to

look after the worthy unfortunate, but now, nine-tenths of their effort is with born incompetents. And that is why something like eight-tenths of their effort is practically futile, so far as any permanent reconstruction of these individuals is concerned. With impossible human beings, nothing is possible. Social workers habitually wonder at the proverty of results; if they knew the fundamentals of heredity they would cease to wonder.

THE DETERMINING FORCE OF HEREDITY

All this environmental work, and all education and training of youth, essential as they are, do next to nothing toward eliminating hereditary defects. It is all development work—trimmings, as it were, with which we bedeck the individual for his journey through life—and the trimmings die with him. They do not affect our biological makeup. Education doesn't get into the blood.

The only thing that descends through the generations is the *capacity* to respond to education and training. Heredity furnishes the mechanism—determines the physical and mental quality of the human material with which we have to work. Upon the inherited quality of the child depends the quality of the man we can make of him. A carpenter cannot make a mahogany table out of pine boards; and if we breed in greater numbers from the mentally inferior types, we are going to have an ever increasing proportion of children incapable of being developed into upstanding men and women.

How have we come so far on the way to racial degeneracy without any visible attempt to check ourselves? Mainly because of a pious horror of any action that looks like interference with the right of parenthood. It is a hangover sentiment from the ages of ignorance and superstition which we cannot shake off, in spite of our present clear knowledge that a vicious parenthood is flooding us with a vicious progeny.

THE UNGUARDED SOURCE OF HUMAN MISFITS

Our impotence in this respect looks the more ridiculous when we consider how keen we are to prevent any ill-favored specimens among our plants, pigs and cattle from reproducing their kind. We are up to the minute in guarding the heredity of every other useful species, and back with the Pharaohs in protecting our own.

So we sit helplessly by, with full knowledge of what is happening to us, while any two people not in jail or the lunatic asylum bring children into the world regardless of consequences.

If their children prove to be hopeless misfits, we guide them through the special room, and perhaps to the reformatory. But do we look back to their source with a view to preventing more of their kind? Not at all. We supinely await the further product of their usually worthless parents. Or do we make the slightest attempt, later on, to restrain the fecundity of these children themselves? About one in ten, helplessly imbecile, are segregated in feebleminded institutions; the other nine-tenths are free—except for the periods spent in jails and prisons—to exercise the one sturdy function with which nature seems to have endowed them.

BURDEN OF CORRECTIVE MACHINERY

Of all the relics from the past, this superstitious notion of the inviolability of parenthood is the most expensive—in money, in human misery, in social maladjustments which we must forever be combating. Is the burden of corrective and philanthropic enterprises becoming heavy? It will grow vastly heavier with each succeeding generation. Special rooms, reformatories, asylums, prisons and the present swarm of charities will increase by leaps and bounds, because the sort of humans who cannot be taken care of in any other way is increasing by leaps and bounds.

NEED FOR EDUCATION IN THE LAWS OF HEREDITY

The one and only way to clear the race of its burden of hereditary unfitness is to cut off its reproduction at the source. The first step toward that end is to promote a general understanding that every ill-favored, shiftless, weak-minded delinquent is as unfit for perpetuating the race as is a scrubby, unintelligent, underbred horse to take its place in the breeding stable. Not that we shall ever come to methods approaching those for perfecting domestic breeds; that is as unthinkable as it is unnecessary. Heaven forbid that we should have standardized human beings, even if such were possible. But we *may* entertain the worthy hope that, sometime, we shall have the courage to deny parenthood to those who are manifestly unfit to produce American citizens.

A GOOD ENVIRONMENT NECESSARY

What determines unfitness for parenthood? Eugenists are inclined to put the whole stress on heredity, and to seek too much exactness in applying their scientific knowledge. But common experience should tell us that unfitness for parenthood is not by any means a matter wholly for biological determination. Next to being well born, a child needs a good environment. When we see men and women who are perpetually at odds with the social order, incapable of all ordinary adjustments, we ought to know just as well that they will be wholly unfit to rear children as if we had studied their pedigrees for ten generations back. Control of unfit parenthood can never be reduced to an exact science. The problem demands a copious injection of common sense and every-day experience into the knowledge which biology has given us; it should not be left to the faddist adherents of either heredity or environment. A good quality of both is equally essential.

EXAMINE CHILDREN IN PUBLIC SCHOOLS

But any system for restricting parenthood, to be effective, must not wait for demonstrations of parental unfitness. Bear in mind that irresponsibles, incapable of self-restraint, begin their sex activities years earlier than normal people. The public school is the place for the scrutiny of the nation's future mothers and fathers. It is not too much to say that in the great majority of cases the final determination should be made before the child leaves school, or as soon thereafter as its actions give the further necessary evidence. It is also a safe assertion that most mental defectives who attain their twentieth year unrestrained have added to the race's load of defective children. The need for early action cannot be too strongly emphasized.

TO CHECK INCREASE OF THE UNFIT

How shall we put denial of unfit parenthood into effect? Certainly not by legal enactment against marriage. That would mean nothing to the average incompetent.

Institutional care, perhaps in farm communities, might well be put upon at least five times as many of the obviously defective as are now segregated. But there would still be as many more, of the "borderline" types, for whom segregation would be an unnecessary deprivation of liberty. Sterilization is the usually proposed expedient for such cases. It is something to which the public has yet to be educated, but once it is understood it undoubtedly will have the leading part in any accepted scheme of race regeneration.

Any proposal to suppress unfit parenthood is bound to meet violent opposition. But it will meet none more blindly stubborn than those who hold that proper environment can overcome any adverse effects of heredity. They admit hereditary defects, but would camouflage them with more thorough training of the individual and a bettering of social conditions.

TO MAINTAIN QUALITY OF SPECIES IN WELL-ORDERED COUNTRY SHOULD BE AIM OF SOCIETY

But suppose that, for the moment, we put aside the claims of heredity, and

view our manner of rearing humans from the environmental standpoint alone. The first big fact that we meet —a fact easily demonstrable by anyone who will go from the silent streets of the thrifty to the swarming alleys of the thriftless—is that at least three-quarters of all children are born to living conditions well below those of the average, as measured, not by wealth, but by the quality of the parents,—while a scant one-quarter have the advantage of homes above the average.

Now what enthusiast for the power of environment would deliberately raise most of his flowers and chickens under adverse conditions? Yet this is exactly what we are doing with the human species.

So from the viewpoint of either heredity or environment our method of perpetuating humankind is a complete reversal of nature's scheme for maintaining quality of species. We may be drifting slowly, but we are *drifting*—toward a depreciated race. The histories of Babylon, Egypt, Greece and Rome show us that each, in its turn, went to its final blaze of glory with its population reduced to a vast mass of mediocrity—a huge, incoherent proletariat, ridden by a handful of plutocrats whose culture savors of a splendid degeneracy.

Is such to be our end, generations hence? Nobody knows. All we really know is that we are following the beaten path of the ages. Yet we need not follow it a day longer than we choose. And the first move toward regenerating the race is to cut off unfit parenthood. Rid the race of the half-man, and human misery, in a well-ordered country like America, will be more than cut in half.

Tests of Intelligence and Achievement

STANDARD EDUCATIONAL TESTS, arranged and standardized by M. E. Haggerty, professor of Educational Psychology at the University of Minnesota. Yonkers-on-Hudson, the World Book Co., 1920.

"With the extension of educational investigation it is becoming apparent," says Professor Haggerty in his Manual of Directions accompanying these tests, "that too little attention is being paid to the native intelligence of children. Attention was first directed to the matter through the presence in the schools of a considerable number of mentally defective and in some cases feebleminded children. These children presented serious problems to teachers and forced themselves upon the attention of superintendents and others. The result was the organization of special classes for teaching them and the development of special testing methods for their proper classification.

"More recently attention has been called to the presence in the school of a number of superior children. The number of these is probably as great as that of the backward and feebleminded. The work of Terman, Whipple, and others shows that such pupils can be identified through the use of intelligence tests and that they can with profit to themselves and to others be separated from the regular classes and be taught as a special group."

Professor Haggerty has followed the example of numerous other psychologists in preparing tests suitable for the different grades in school. They are based largely on the army tests.—P. P.

A GRAFT-CHIMERA IN THE APPLE

Evidence That the Two Distinct Types of Fruits on the Same Tree Are Not Due to Bud Sporting or Top-Grafting

A. B. STOUT

New York Botanical Garden, New York City

THE accompanying plate illustrates two distinct sorts of fruits borne on an apple tree that has evidently never been top-grafted. The fruit shown at the right is typical of the King variety; the other is nearly identical with the fruits of the Rockbury Russet. The two types of fruit are quite distinct in respect to size, color, character of skin, flavor, and texture, and the leaves of the branches bearing them are noticeably different especially as to size.

The tree which bears these two kinds of foliage and fruits stands in the vicinity of Geneva, N. Y., in an orchard owned by Mr. T. D. Whitney. Mr. Whitney helped plant the tree in 1862, has resided on the place ever since, and has for many years observed the dual nature of the tree.[1]

At the present time the tree is large and well developed and is about 30 feet in height and in spread. Most branches bear the Russet fruits. About 20 of the smaller branches bear King fruits and these branches are well scattered, being found among the tip branches of all of the large main divisions of the trunk.

EVIDENCE OF THIS AS A CHIMERA

The occurrence of two more or less distinct kinds of fruit on the same tree may be due to any one of three causes, as follows: (1) vegetative variation or bud sporting, (2) the usual consequence of top-grafting, or (3) an unusual and somewhat indirect result of grafting, which gives a plant in which the two kinds of cells belonging to stock and scion become associated together in the same branches, giving what is now known as a chimera.

Dr. U. P. Hedrick, of the Geneva Experiment Station, is convinced that bud sporting has not occurred in the tree in question. He does not consider it probable that these two types of fruit which differ so widely in several characters can be so closely related as to be parent stock and bud sport.

Mr. Whitney is positive that the tree was never top-grafted. His continuous association with the orchard from the time of its planting to date, his wide knowledge of apples, and his definite recollection of this particular tree make this point seem certain. The scattering branches which bear King fruits have not grown from King scions that were grafted to branches of a Russet tree.

CHIMERAL FRUITS FOUND

Very definite evidence that the King branches are not simple top-grafts is also seen in the chimeral fruits which are sometimes found. Such fruits have a segment that is King while the rest are Russet. These show that the two cells of the King and Russet varieties are associated together in single twigs, leaves and fruits. Such a combination has thus far not been produced as a direct result of grafting but chimeras of this class or rank very frequently occur in bud sports, they have now been produced experimentally, and they have also arisen incidentally as indirect products of grafting, giving what has frequently been called "mixed plants."

Several cases of "mixed plants" have long been known to horticulturists and for many years these plants aroused much discussion as to their origin and nature. One of these is the Bizzaria or-

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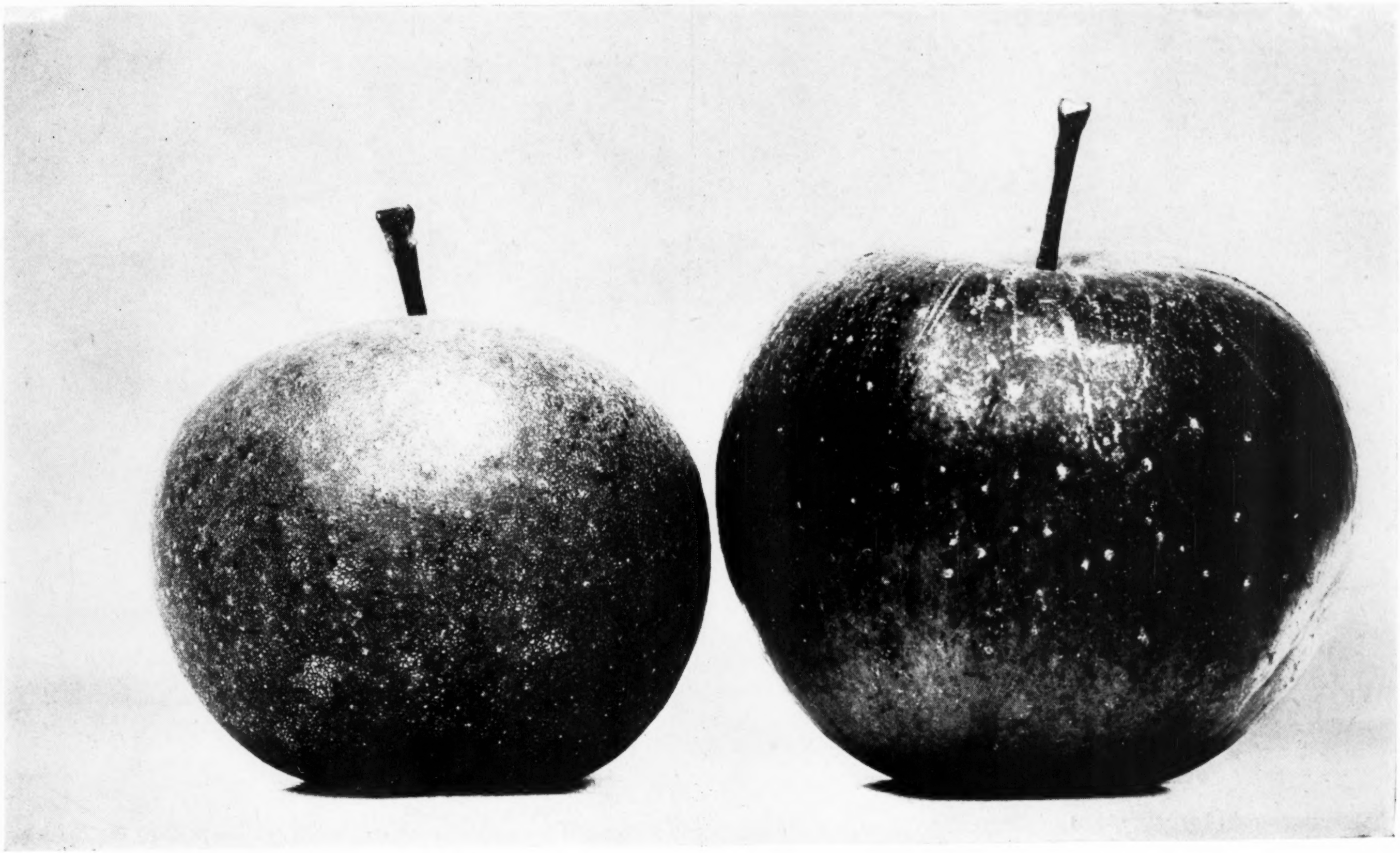
[1] The writer recently had the pleasure of visiting this interesting tree together with Dr. U. P. Hedrick, Mr. O. M. Taylor, and Mr. W. O. Gloyer, of the staff of the New York Experiment Station, all of whom shared in the observations recorded here.



TWO VARIETIES OF FRUITS ON THE SAME TREE

An interesting case of a graft-chimera in the apple is shown in these two distinct sorts of fruits produced by the same tree. The fruit at the right is of the King variety, and the one at the left is a Russet. The tree bearing these fruits has two different kinds of foliage well scattered throughout the branches. The fruits differ distinctly in size, color, flavor and texture. Enlarged about one-fourth. (Fig. 28.)

ange which appeared in Florence, Italy about 1644. On some of its branches oranges are produced, on others citrons develop, and on other branches the fruits are part orange and part citron as shown on page 522 of Vol. 5 of this Journal (December, 1914). Another plant known as *Cytisus Adami* originated in 1825 as a branch of a plant grown from a graft between *Cytisus purpureus* and *Laburnum vulgare*. Some branches of this plant are pure *Cytisus purpureus*, others are pure *Laburnum vulgare*, others are various mixtures of the two, and others bear leaves that are intermediate in character. Several types of plants are known which appear to be mixtures of the two species *Crataegus monogyna* and *Mespilus germanica*. All of these have been propagated vegetatively and have been objects of more than usual interest. How these plants originated has been a matter of no little discussion and speculation among botanists and horticulturists.

GRAFTING TO PRODUCE CHIMERAS

The experimental production of chimeras in rather recent years has shown very clearly how such plants can arise incidentally through the practice of grafting. By a simple but ingenious arise incidentally through practice of grafting. By a simple but ingenious method of experimentation Dr. Winkler, now Director of the Botanical Garden at Hamburg, produced such plants under observation and control. He used the tomato and nightshade, two distinct and well-known species with marked differences in leaves, flowers and fruit. He made grafts, and when the scions were well established he decapitated the branches by cutting through the points of contact between scion and stock, thus exposing on the cut surface the two kinds of tissue and the lines of contact between them. On this surface a callus formed from which buds arose. If a bud arose entirely from the part that was nightshade the branch was nightshade only; if from tomato tissue the branch was pure tomato. If, however, a branch arose over the line of juncture it was composed partly of tomato and partly of nightshade tissue.

TWO KINDS OF CELLS IN SAME BRANCH

Such branches were called "chimeras." The simpler of these show vertical lines of differentiation; one sector bears the leaves, flowers, and fruits of the tomato while the rest of the branch bears those of the nightshade. Such branches and the plants grown from them by vegetative propagation are called "sectoral chimeras." In such an association of two kinds of cells, each sort retains its own character and the leaves, flowers, and fruits of the two sectors are readily to be identified.

Occasionally, however, branches arose which produced leaves, flowers and fruits that were intermediate or mixed in character. One of these (named *Solanum tubingense*) bears simple leaves like the nightshade but the leaves are more or less lobed and are hairy as the tomato. Another (*Solanum proteus*) resembles the tomato more than the nightshade; the stems and leaves are hairy but the fruits are smaller than those of the tomato. Several types of intermediates were produced and for a time it was believed that these were true graft-hybrids resulting from the actual fusion of certain vegetative cells of the tomato and the nightshade in the region of contact in the graft. Later, however, a study of the internal and minute st.ucture of the cells in these plants revealed that the two kinds of cells characteristic of the tomato and the nightshade are both present, and that one kind exists as one or more continuous layers covering the other kind. It was found that *Solanum tubingense* has one outside or periclinal layer of tomato cells covering a core of nightshade tissue and that *S. proteus* has two such periclinal layers. Other types of the intermediates have one or more outermost layers of nightshade cells covering tissue of the tomato. The plants were thus found to be periclinal chimeras. A photo of four

of these intermediates or periclinal chimeras is shown in *The Journal of Heredity*, Vol. 5, No. 12, and an excellent discussion of how such chimeras are produced is there given.

Similar study of *Cytisus Adami* and the *Crataegus-Mespilus* so-called graft-hybrids showed that they are also periclinal chimeras with one or more cell-layers of one species covering a body of cells of the other species.

INTERACTION OF DIFFERENT KINDS OF CELLS

The rather intimate association of the cells of two different species in the same stem, leaf, flower, and fruit is especially interesting in view of the mutual interactions, mechanical and physiological, that may occur. The evidence indicates that the two kinds of cells remain independent in respect to their own hereditary characteristics, but in the periclinal chimera they interact producing organs that are intermediate in character. Slight differences in the arrangement of the same two kinds of cells also produces vegetative and floral s ructures and fruits that are quite different in appearance.

While the investigations indicate that the supposed graft-hybrids are in nature only periclinal chimeras, the production of true graft-hybrid through a fusion of vegetative cells is still to be considered possible. In fact Dr. Winkler has presented evidence that this is the case in one adventitious branch that arose from a decapitated graft between the tomato and the nightshade.

The production of sectoral and periclinal chimeras by experimenal means readily shows how such branches can arise incidentally on plants grafted by the ordinary methods. New and adventitious buds may arise from the region of union between stock and scion, especially if the upper part of the scion dies. If such a bud arises over the line of contact it may develop as a chimera. Dr. Winkler's studies show that sectoral associations develop more frequently than do the periclinal.

CHIMERAS THROUGH BUD SPORTING

It should be noted that intra-varietal sectoral and periclinal chimeras frequently arise through bud sporting. Such partial bud sports have been described frequently in the pages of this jour n l, especially for such conspicuous cases as the loss of green color which is carried on into various new branches.

Some of the albomarginate types of variegated plants (of *Pelargonium* for example) are clearly periclinal associations of green and white cells all of which belong to the particular variety. In the original sport, most probably, a single cell lost the ability to produce the green pigment and this cell was so placed in the growing point that its multiplication by division gave one or more layers of white cells. Once established the relative position of the white and the green cells was maintained rather uniformly in the subsequent development of branches.

It is also to be noted that, in many sorts of variegated plants, though the pattern strongly simulates a chimeral arrangement, it is really due to physiological conditions affecting development of color in the leaf as a whole. In these the colored and colorless areas often cut across cell layers or histogens. Much remains to be learned regarding the development of such local areas of infectious chlorosis, as well as the development of various patterns of anthocyani.n coloration in flowers and foliage.

PROBABLE ORIGIN OF THIS CHIMERA

Mr. Whitney's tree bearing Russet and King fruits is evidently a chimera that has grown from a bud that arose on the line of contact between scion and stock, and is hence to be considered as a graft-chimera. Presumably a scion of King was grafted to the root of a seedling of the Russet in the method of ordinary nursery practice. At any rate the tree is clearly an inter-varietal chimera: some branches are composed of sectors of tissue of two varieties; lateral branches arising from

the sector of King are pure for King; those arising from the part that is Russet are pure for that variety, and those that happen to arise from the line of contact continue to be sectoral chimeras. It is possible that in some of the branches the two kinds of tissue are in periclinal relationship and that some fruits possess a skin of one variety and a core or body of the other. Rather careful examination of a large number of fruits by one competent to judge the flavor would be necessary to determine this point.

A French Student of the Birth-Rate

La Natalité, par Gaston Rageot, professéur agrégé de philosophie. Pp. 296, prix f. 5.75. Paris, Bibliotheque de philosophie scientifique, Ernest Flammarion, editeur, 1918.

After discussing with clarity and relentless logic the various conceptions of the population problem that are current, Professor Rageot outlines ways in which he believes the French birth-rate can be increased. They are mostly in the direction of making family life a more prized privilege, either by education (creation of public sentiment), economic changes (e.g., inheritance of land), or political changes (less military service for fathers, extension of suffrage to women), and the like. While the constructive proposals contain nothing particularly new, the book as a whole is one of the most brilliant and penetrating studies of the birth-rate that has ever been published.—P. P.

Eugenics Made Easy

The Racial Prospect, by Seth K. Humphrey. Pp. 261, price $2. New York, Charles Scribner's Sons, 1920.

Mr. Humphrey has rewritten his book "Mankind," reviewed in the *Journal of Heredity* in November, 1917, and has made of it an unusually successful presentation of the essentials of eugenics in the simplest terms. He offers no statistics, no pedigree-charts; instead he gives his readers the elementary, yet vigorous and epigrammatic kind of writing that one expects to find in a newspaper editorial. It is a difficult job to do well, but on the whole Mr. Humphrey has done it well; and it is worth while to have the problems of eugenics stated, for once at least, in kindergarten form.

The author realizes that mere statement of the problem will not solve it; but his own solution is not up to the level of the rest of the book. In the last chapter he takes a look forward to the time when the lower 5% of the population will be segregated or sterilized, while the hundreds of thousands of superior celibate women will become mothers by virtue of a state-organized system of artificial insemination. This sort of patent-medicine cure for the ills of society is not what will make eugenics prevail, and it is a pity that Mr. Humphrey, realist as he is, can not appreciate that human progress does not come by such simple expedients. The eugenic welfare of a nation is bound up with almost every manifestation of the nation's activity; and by hurdling over this fact Mr. Humphrey has fallen short of producing a book that could be commended without reservations.—P. P.

BREEDING EARLESS SHEEP

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FOUR years ago the writer reported[1] a rather clear cut case of a simple Mendelian unit character governing the transmission of ear length in sheep.

The following extract from that article will explain the traits differentiating the unlike parental ear types.

Short ears as referred to here are of a distinctive type with nearly straight lines running from the base and forming an abrupt sharp point. They are also somewhat thicker than the ordinary type of ear. The longest of these ears so far observed in a mature animal measure 7 cm. (2¾ inches). Since no intermediate types either as to length, shape, or thickness have so far appeared, length as a character forms quite a distinctive contrast between this type and that of Rambouillet ears, which measure about 11.5 cm. (4½ inches); Southdowns, which measure about 9.5 cm. (3¾ inches); and Shropshires and native, which measure about 10 cm. (4 inches). In fact, all ordinary ear lengths observed among various breeds and types seem to run close around 10 cm. (4 inches).

The results of the matings as shown by diagram were such that the short ear trait was accepted as a gametically pure parental unit character. S indicates short ear; L, long ear; offspring grouped one above the other indicate twins:

First Cross

Recessive × Dominant or Simplex	♂ 3L × ♀ 69S	=	Matings	3
F_1 Offspring	♀ 127S + ♀ 222S + ♀ 254S		Offspring	3S

Back Cross

Recessive × Simplex	♂ 3L × ♀ 127S	♂ 361L × ♀ 127S	=	Matings	3
Offspring	♂ 255L + ♀ 313S ♀ 256S ♀ 314S	♀ 459L ♀ 460L		Offspring	3S–3L

Back Cross

Extracted Recessive × Simplex	♂ 255L × ♀ 127S	=	Matings	1
Offspring	♂ 422S ♂ 423L		Offspring	1S–1L

$F_1 \times F_1$

Simplex × Simplex	♂ 422S × ♀ 256S	♂ 422S × ♀ 127S	=	Matings	3
Offspring	♀ 573S + ♀ 461S ♀ 462L	♀ 572S		Offspring	3S–1L

Although but a few individuals possessing the short ear trait had been bred, the result of the matings was so clear cut that further breeding was discontinued.

Incidentally, however, the short ear trait was reintroduced through a ram, No. 632, who was a son of No. 422 by a long-eared ewe.[2] This ram was secured for the purpose of introducing a high twin potency into a flock of seven long-eared ewes kept for a study of this problem.

These matings and offspring are shown in the following diagram (S indicating short ear, L, long ear):

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[1] Ritzman, E. G. Mendelism of Short Ears in Sheep; Journ. Agrl. Research, Vol. VI, No. 20, August 14, 1916.

[2] No. 632 was bred by Dr. C. B. Davenport of the Station for Experimental Evolution.

(Fig. 29.)

(Fig. 30.)

ORDINARY LONG-EARED SHEEP AND SHORT-EARED VARIATION

The ram at the left (♂ 3L) has ears of the usual length. The ewe at the right (♀ 127) shows a short-eared type which appeared as a mutation. This variation has behaved as an imperfectly dominant unit character since its appearance. The homozygous form is illustrated by the wholly earless sheep shown below.

EARLESS SHEEP, FRONT AND SIDE VIEWS

This ram (♂ 698), which wholly lacks external ears, was produced by mating two of the short-eared sheep at the N. H. Experiment Station. It is believed that the absence of ears is due to homozygosis in a factor which is responsible for the short-eared type when heterozygous. (Fig. 31.)

	Back Cross		
Simplex × Recessive	♂ 632S × (♀ 106L + ♀ 486L + ♀ 501L + ♀ 559L	=	Matings 7
Offspring (1917 crop)	♂ 650S + ♀ 651S + ♂ 652L + ♂ 654L ♂ 653L		Offspring 5S–3L
Simplex × Recessive	♂ 632S × (♀ 611L + ♀ 623L + ♀ 624L		
Offspring (1917 crop)	♂ 655S + ♂ 656S + ♀ 657S		

The result of these matings was five short and three long-eared individuals, the former being simplex and the latter pure recessive since they were derived from a simplex x recessive back cross. The following year, ram No. 650, a simplex offspring, was bred to the same list of ewes with the exception that ewe No. 616 replaced ewe No. 106, both pure recessives, with the result shown diagrammatically as follows:

	Back Cross		
Simplex × Recessive	♂ 650S × (♀ 486L + ♀ 501L + ♀ 559L + ♀ 611L	=	Matings 7
Offspring (1918 crop)	♂ 658S + ♂ 659L + ♀ 661L + ♀ 662S ♂ 660S ♀ 663S		Offspring 4S–6L
Simplex × Recessive	♂ 650S × (♀ 623L + ♀ 624L + ♀ 616L		
Offspring (1918 crop)	♀ 664L + ♂ 665L + ♂ 666L ♀ 667L		

As the character of the matings again represented a back cross of simplex x recessive the result was quite similar as, in the preceding year, and in fact the two seasons' crop, gave exactly the theoretical proportion to be expected from such a cross, namely, 9S + 9L.

The following year, No. 650 was bred to four ewes only. Three of these (486, 501, and 550), being pure recessives, dropped four offspring, two short and two long eared lambs, which again maintained the proportions of a simplex x recessive cross.

SIMPLEX CHARACTER ESTABLISHED

Out of a total of 32 offspring (including two out of No. 127 not shown in diagram) derived from a simplex x recessive cross, 16 were short ear and 16 long ear. This remarkable agreement of results obtained actually with results expected theoretically establishes beyond doubt the simplex character.

The interesting feature, however, developed from the mating between this simplex ram and ewe No. 651 which was also a simplex, corresponding, therefore, to a mating inter se of F_1 the result being a ram lamb No. 698 which had no ears.

EARLESS TYPE A PURE DOMINANT

Only four offspring from simplex x simplex matings had been obtained before and these gave the proportion 3S:1L. While the short ear was formerly accepted as the somatic expression of the pure dominant and of the heterozygote, assuming complete dominance, it now seems clear that the pure dominant is somatically earless and the heterozygote, showing only imperfect dominance, is short eared. In other words, if a single dose for repressing ear length is present the ear is approximately half normal length but if two such doses come together the ear is entirely eliminated.

In this we have a clear-cut case of a heterozygous combination that can be easily distinguished from the homozygous dominants and recessives, and it forms a rather striking example of the "presence and absence hypothesis" of Correns,[3] Bateson,[4] and Hurst.[5]

[3] Correns, C. 1912, Die Neuen Vererbungsgesetze. Gebruder Borntraeger, Berlin.
[4] Bateson, W. 1909. Mendel's Law of Heredity. Cambridge University Press, Cambridge.
[5] Hurst, C. C. Experiments with Poultry. Rep. Evol. Committee Roy. Soc. 1905, II. p. 131.
[6] Hurst, C. C. Experimental Studies on Heredity in Rabbits. Linn. Soc. Journ. Zool. 1905, xxix. p. 283.